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CABINET MAKING

Principles of Designing, Construction and Laying Out Work.

By J. H. RUDD,

With Chapters by
C. A. ZUPPANN and WALTER K. SCHMIDT

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PREFACE

This book has been prepared to supply a double demand. It has been written with the needs of the cabinet maker—the manufacturer of household furniture—in mind, as well as the demand which has recently been created for a simple and concise text book on cabinet making for the use of the increasing number of teachers in the manual training, technical and trade schools. In the preparation of the English edition I had in mind students other than those who come to me for instruction while preparing themselves for the trade examinations which my American publishers assure me are peculiar to my country and not to theirs. The chapters which follow were first published in the *Cabinet Maker*, of London, without thought of their embodiment in book form. They were also almost simultaneously published in the *Furniture Manufacturer and Artisan* of Grand Rapids, Mich. The appreciation with which the articles were received by the publishers of both of the papers named has encouraged these publishers, as well as myself, to embody the chapters in book form, and the result is this volume.

An attempt has been made to place upon the market a work within the reach of all. The sub-division of the trade itself and the introduction of machinery combined with the decline of the apprenticeship system has left the cabinet maker, generally speaking, in a somewhat inferior position today when regarded as an all-round craftsman. Many young men are highly efficient in one department but have only vague ideas of the requirements in other branches.

The object of this volume is to describe and illustrate pieces of furniture in which difficulties of construction occur, and which involve the introduction of mechanical devices not met with in everyday practice. Familiar pieces have not been considered, explanation in such cases being regarded as unnecessary. The book makes no claim to being a work on design, but it does claim to deal fully with the whole process of manufacture, embracing factory planning, estimating and costing, the measuring of rooms, draught-

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ing, setting out, the seasoning of timber, veneering and the construction of various types of panelling.

As a teacher of cabinet making it has been my endeavor to treat the subject as tersely as possible, but, at the same time, no explanatory detail essential to the successful construction of the articles described has been omitted.

With my consent and approval my American publishers have adapted the chapter on cost accounting to the practices in the United States, and happily, I think, introduced a chapter on this subject by Mr. C. A. Zuppann, particularly designed for use in manual and technical schools where cabinet making is being taught. Surely cost accounting is as important a subject for the manufacturer of the future as anything herein treated. They have also adapted the standard sizes of furniture, etc., to the practice in the United States and with my approval introduced chapters on the construction of fuming boxes, designed for factories of large output and simpler forms of the fuming box for small establishments. These chapters are by Walter K. Schmidt. With the prevailing vogues in finishes, these chapters should be of value and importance to those students of cabinet making who may purchase this modest volume.

J. H. RUDD.

Barnstaple, England.

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FACTORY PLANNING

NOTES AS TO THE DISPOSITION OF MACHINERY

The best locality to select for the erection of a factory is greatly influenced by the class of trade the manufacturer caters for; thus, for instance, if making for the export trade he would, if possible, choose the outskirts of a seaport town in order that the words f. o. b. on his estimates and quotations would not mean a serious item of expenditure with railway companies. On the other hand, a maker of the highest class of goods, such as would only be used by the wealthy class of the community, would choose the neighborhood of some great city, but far enough outside to escape the heavy taxes which a crowded population entails. Owing to the general use of motor traction, railway facilities need not play so large a part in his calculations as heretofore. To be too far away from a large center often means difficulty as regards labor. The staff may be augmented rapidly to cope with an unforeseen rush of work at short notice in a city, but this is obviously impossible in a country district. These are suggestions which would occur to a manufacturer who had the world before him and was contemplating building a furniture factory. As a matter of actual fact, this state of affairs very seldom presents itself. His business has probably grown from a small concern, and he is bound hand and foot to the locality, and possibly, to the premises where his father or grandfather started the business some 50 or 60 years before his time; so it is, unfortunately, often the case that haphazard arrangements, made half a century ago, very much hamper the effective working of a business down to the present day. This is not only the case, of course, in factories, but is a law of universal application wherever there is progress. Take, for instance, the case furnished by appliances for locomotion, as instanced by Spencer, who says: "Observe how the inconveniently narrow gauge (which, taken from that of stage coach wheels, was itself inherited from an antecedent system of locomotion) has become an insuperable obstacle

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to a better gauge. Observe, also, how the type of carriage which was derived from the body of a stage coach having become established, it is immensely difficult now to introduce the more convenient type later established in America, where they profited by our experience but were not hampered by our adopted plans. The enormous capital invested in our stock of carriages cannot be sacrificed; gradually to introduce carriages of the American type by running them along with those of our own type would be very difficult because of our many partings and joinings of trains, and thus we are obliged to go on with a type that is inferior."

So, in exactly the same way, rapidity of manufacture and convenience of working is impossible in many factory premises because so many of the appliances are obsolete. When this is taken into account it will be seen how necessary an item on the annual balance sheet is a considerable sum for the depreciation of plant and premises. But although what we may call "inherited defects," as mentioned above, are so often to be met with, it will doubtless be of service to roughly sketch the ideal disposition of machinery in modern cabinet making premises.

If it is at all possible, a railway siding should run right through the factory yard, and this should be so planned that the balks of timber may be unloaded in close proximity to the vertical frame and large circular saws. The motive power for driving the machinery will be determined somewhat by local circumstances and the size of the concern. If only a small plant is installed, the best way is to secure premises with a cheap electric power supply near the buildings, so that the current may be led to a distribution board, and thence to separate motors driving the various groups of machines. If electric energy is not available in the district, inexpensive and efficient motive power is a gas engine with suction gas plant. In this case all the machines have to be fixed up in relation to the line shafts driven therefrom.

It cannot be gainsaid that electricity is by far the most flexible means of driving, and the machinery can be placed in a far more convenient manner when it is used. The waste from the machines is burned for heating the drying-rooms and the workshops, with their steam plates and glue

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chests; the boiler for the burning of this waste from the machines should have an especially large grate. The selection of machines is of the utmost importance, both as regards their being exactly suitable for the users' requirements and also as to whether they are absolutely necessary. It is better to lay down a plant adequate for present needs and add to it as circumstances and the growth of the business dictate, for the reason that machinery which is standing idle has a tendency to depreciate, and time and trouble is involved in preparing it for use after it has been laid by for some time. Further, regarding selection, it is the height of folly and very false economy to select a machine simply on account of the price being lower than another. So-called cheap machines prove a constant worry, and instead of being labor-savers (the essential qualification of a machine), they are, in reality, labor-wasters, besides the fact that the work they turn out is inferior. The difference in first cost between good and cheap machinery is rapidly counterbalanced by loss of time owing to breakdowns, with consequent cost of repairs; and, of course, the work done by them being inferior in quality requires considerably more hand finish than that done by a thoroughly reliable machine. As regards up-keep, all machines should be kept in the very best order, and as soon as any bad work becomes apparent the best policy is to overhaul that particular machine and remedy the defect immediately.

The Disposition of Machinery

The machines should be placed as nearly as possible in the same order as a worker proceeds when carrying out the various operations by hand. In a factory where the manufacturers convert their own timber, the logs first enter the saw mills, where they are dealt with by heavy frame and circular saws. The drying kiln should be in close proximity to the mill; time and labor will be saved if rails are laid down from the mill to the drying kiln and a system of trucks provided on which the lumber is piled and easily conveyed to the drying rooms. The seasoned material is next roughly squared to size by the aid of pendulum and circular saws and then passed to the various machines, taking the following order:

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Jointers.
Planers for facing and shooting one edge.
Planers for thicknessing.
Rip saws and cross-cut saws.

Morticing. Tenoning.	Band and Jig Saws. Spindle Moulding and Shaping.	Glass-papering. Dovetailing.	Boring, Vertical and Horizontal Grooving.

The reason for this disposition of machines will be apparent. The work will flow through the shops by this arrangement in a continuous stream without ever returning on its own tracks. Factory trucks for moving the various runs of "stuff" are of the greatest service. These should be capable of carrying heavy loads and should be so constructed as regards the wheels and bearings that they will revolve on a stationary axis. It is well to install in the machine shop a small department for the grinding of the various cutters and knives used in planers, moulders, and other machines; thus sub-dividing the labor as much as possible, as one man constantly employed on it will become very proficient in this sort of work. Here machines fitted with emery wheels for grinding cutters, etc., should be laid down. The operative responsible for this department should be the stock-keeper of the various cutters and be made responsible for them.

So much for the machine shop proper. There are, of course, auxiliary departments which are better self-contained—for instance, the inlaying and veneering department, where of necessity the temperature is much higher, are better kept to themselves in a separate shop. In this department the heavy veneer presses and large glue chests should be situated.

What may be termed the minor operations, such as carving and turning, in a word, the more decorative side of woodworking, should be kept in separate departments, and if a carving machine is installed and the motive power admits of it, it is well to plan this in close proximity to the foreman carver, as a good deal of care is necessary in the proper adjustment of the patterns. In a large machine factory, in addition to the ordinary lathes, one at least of which should be capable of taking the maximum length of newel, there will be drums for square turned work and a large vertical plate for turning circular table tops. On its exit from the machine department, the stuff enters

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the store. This is a department which should receive the maximum of attention from the point of view of ventilation and equable temperature. At one time the cabinet shops proper in factories were devoid of machinery, but of late years it has become a practice in many shops to install one or two labor-saving machines likely to be of service in facilitating the maker's work, such as a circular saw, sand-papering drums and mitering machines. This is especially advisable where the machinery is run by electric motors, as there is no waste of energy when the machines are standing idle, as, from the nature of the case, they cannot be in constant use. Except for these, in the cabinet making, fitting and polishing shops, machinery is conspicuous by its absence, and its next appearance is in the packing department, where a weighing machine is of course a necessity.

This department is, of course, planned close to the railway siding, and both the platform from which the goods are loaded and the trucks themselves should be under cover, to prevent damage by weather. Where heavy cases for export have to be handled, packing is greatly facilitated by the installation of a small overhead crane, otherwise an immense amount of manual labor is requisite to remove the bulky cases. It goes without saying that the utmost cleanliness should be observed in the machine shops, as the waste material is of an inflammable nature, and disastrous fires have often resulted from sawdust collecting round the bearings revolving at a high speed and causing spontaneous combustion. Prevention is always better than cure, and in every well-equipped machine factory some dust collecting system which carries off the dust from machines causing much waste, such as planers and sandpapering machines, should be installed. As regards fire prevention, the best tribute to the efficiency of the overhead sprinkler system is the large reduction in premiums made by insurance companies where this system is installed. There is practically little or no upkeep involved and the only time of the year at which any care must be taken is during a heavy frost.

NOTE.—It must be remembered, of course, that for small shops, there are on the market general woodworkers which combine in one and the same machine many of the processes referred to above.

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A SIMPLE COST SYSTEM

By C. A. Zuppann
Union High School, Grand Rapids, Mich.

In this day of scientific management, an analysis of shop methods and costs is demanded by every progressive factory. The school equipped for teaching shop work—some prefer the old misnomer, "manual training," others "industrial science" or "industrial arts"—should not lose sight of this demand. Each article produced by the school shop should have a known cost, and this cost should be inclusive of all overhead expense, not merely the cost of material. The record of costs should be kept in such a manner that weakness in any branch can be detected and the cause recognized and, if possible, remedied.

The individual pieces constructed in a school, the hours of work and lack of bookkeepers, make the ordinary factory methods of cost keeping impossible. The school shop, however, being similar to the small special order shop, except in the class of labor and hours of work, any cost system which would fit the special order shop could, probably, be used by the school, but there are few, if any, of these shops where cost keeping is complete. In the school shop, each boy is designer, rod-maker, stockman, machine hand, cabinet-maker, fitter and finisher and, if need be, upholsterer for any job. He may help others on some part of one job and, in turn, be assisted by others, or a whole class may be placed on different parts of the same piece of work. This makes time-keeping somewhat detailed.

The more evident items of cost are, naturally: stock, hardware, finish, power and time. As one boy was overheard to remark: "Material, power and time, and the greatest of these is time." Those items less evident are office expense, depreciation, interest, unproductive labor, etc., which are usually called "overhead expense."

This overhead expense can be distributed among the departments, each department or division of the work bearing its share, but as the school shop is practically a unit, this may be entered on the cost sheet in one sum.

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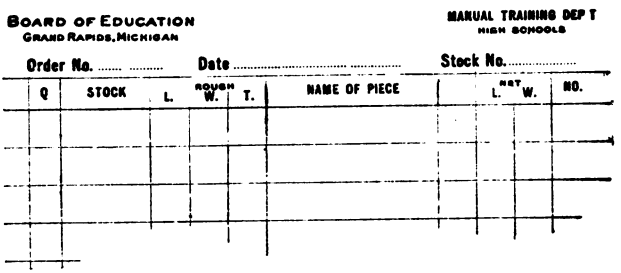
The stock bill used in Union High School, Grand Rapids, is ruled, as shown in the illustration, on 5 x 8 inch yellow cardboard. Each design, as produced in the designing-room, is given a stock number. The orders received by the shop are also numbered, and both numbers and the date of receipt of order entered at the top of the stock bill. It might be thought from this that outside orders are taken. This is not the case. A certain amount of work is done for the school. The remainder of the time is devoted to work which becomes the property of the boy upon the payment of cost of material and power. Naturally, as designs are duplicated in the shop, the stock number may appear many times, the order number but once. For instance, order No. 15 may be for two chairs of design or stock No. 20 and order No. 50 received later, may be for six chairs of stock No. 20. When cards are in use, they are hung near the machines and at the end of the day are filed in a cabinet. The boy who makes the design, of course, fills out the stock bill, giving the information called for; i. e., quantity or number of pieces wanted, kind of stock, rough size. The thickness to which it is to be finished is given under this, name of piece, net size and number of pieces used in each


BOARD OF EDUCATION
GRAND RAPIDS, MICHIGAN

MANUAL TRAINING DEPT
HIGH SCHOOLS

Order No. ..... Date ..... Stock No. .....

Q	STOCK	ROUGH L.	ROUGH W.	ROUGH T.	NAME OF PIECE	NET L.	NET W.	NO.

The Form Used in Ordering Stock

article, leaving a blank column for check of the stock man.

The reverse side of the stock bill is ruled horizontally and on this is kept a record of all materials used, excepting lumber. This includes such items as glue, dowels, screws, fittings, stain, finish, etc. A list is posted in the shop which gives prices of lumber and supplies from which the cost is figured. On the stock bill, therefore, we have a record of cost of all material used in the article.

The time card shown is printed on 4 x 6 inch salmon-colored cardboard. The heading is the same as that on

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the stock bill, except that the number of the time sheet takes the place of the date on the bill. This is necessary when several cards are needed for an order. The columns

BOARD OF EDUCATION
GRAND RAPIDS, MICHIGAN

MANUAL TRAINING DEP'T
HIGH SCHOOLS

Order No. ..... Time Sheet No. ..... Stock No. .....

Date	W. No.	M. No.	Operation	M. M.	Min.	Time Value

The Form for Keeping Time

on the card are for date, workman's number, motor or machine number, operation, motor or machine minutes, minutes of work and time value.

To inaugurate the use of this card means some preliminary work on the part of the instructor. Each pupil and each machine must be numbered. The horse-power per hour used by every machine must be figured, and a satisfactory agreement must be reached with each boy concerning the value to be placed upon his time. All this information should be posted in the shop. The cards must be filed in an easily-accessible manner and the boys thoroughly instructed in their use. Five minutes at "cleaning-up time" is ample for filling out the card.

Some of the orders received from the school may be large and may require the combined work of an entire class. Suppose six boys are put on a job as follows: No. 1 at cut-off saw; No. 2 and No. 3 at rip-saw; No. 4 at jointer, and Nos. 5 and 6 at planer. The boys will note the time of starting to work and the time of starting the machines after "setting up." Any "shut down" of the machine will also be noted and time deducted from running time of machine. No. 1 will finish his cut-off work and, probably, will be able to assist in moving stock. The boys on the rip-saw may be put at cleaning up after finishing their work.

Now as to figuring the time. No. 1 will enter on the card his number, the machine number, the operation (cut-off), the minutes the machine was run and the time he worked at cutting off, which includes the "setting up" of machine. Multiplying the number of minutes used by his

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wage, reduced to minutes, he would enter this as his time value. On the next line he would enter his time and value at moving stock, which would be unproductive labor. No. 2 would enter his time at feeding the rip-saw, giving the time machine was in operation in the machine minute column. No. 3 would enter his time at "tailing" the rip-saw, but, of course, would enter nothing in the motor minutes column. When a large number are working on an order, several cards are used, thus saving delay when time is being entered.

This, seemingly, is intricate, though in practice it is comparatively simple. As stated previously, it requires about five minutes at the close of a two-hour period for a class to make the entries. However, the boys are apt to forget to enter the time unless reminded daily by the instructor.

A suggestion concerning work done by the instructor might not be out of place here. That an instructor may find it necessary to assume the role of workman and perform some operation will be understood. If he would have a workman's number and would enter his time on the card for work requiring a length of time, this would serve as a check on his doing more labor than instructing. If this entry was always made in red ink, it would serve its purpose better, as it must have no time value. As will be seen later, the time of the instructor is figured in the office, or administrative, expense.

That shop mathematics should play an important part in any shop course is a recognized fact. In cabinet-making —in which is included all work from designing to finishing —there is quite a field for problems. The work should include problems on pulleys, belt and speeds; bearings and cutting speeds; areas, volumes and weights; board measure; stock, time, waste, power, cost and floor spacing; also, problems in mixing and matching stains, shrinkage and strength of joints and materials. A definite time each week should be set apart for this work, and at this time all cost of the shop should be figured to date. One-tenth of the weekly shop time would not be too much to devote to this branch of the work. One-fifth would be better.

A suitable card on which to place costs is shown in the illustration. It is printed on 4 x 6 inch blue cardboard and

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the heading is self-explanatory. Most of the items are explained on the reverse of the card. It is evident that from the stock bill properly made out, can be figured the cost of lumber, hardware, fittings and finish. From the time card, the horse-power hours can be computed by noting the number of machine and referring to its horse power which, as mentioned before, should be posted in the shop, multiplying this horse power by the minutes the machine was in operation and dividing by sixty. The result times the price per horse power per hour—usually for commercial power about two cents—will give cost of power for the operation. That this is only an approximation is easily seen. A boy who works the machine to its capacity will use more power per hour than one who delays. It is also plain that a swing cut-off will not use as much power while stock is being placed on the table as when making a cut through three-inch maple. The only way to find the exact power therefore would be to have a motor drive and a meter on each machine. This manifestly is impossible, so the approxima-

COST CARD

Order No. ..... Stock No. .....

Date ..... Purchaser .....

	VALUE	PER CENT.
1. LUMBER		
2. HARDWARE		
3. FINISH		
4. POWER		
5. MACHINE WORK		
6. CABINET WORK		
7. FITTING		
8. UPHOLSTERING		
9. FINISHING		
10. LABOR unprod.		
11. OFFICE, ETC.		
12. DEPREC'N & INT.		
13. DESIGNING		
14.		
TOTAL		

BOARD OF EDUCATION
GRAND RAPIDS, MICHIGAN
Man. Train. Dep't
HIGH SCHOOL

No. of Pieces in Order .....
Average Cost per Piece, $ .....
Cost of Material per Piece, $ .....
Selling Price per Piece, $ .....

Figured by .....

The Complete Cost Card

tion must answer the purpose. By figuring the horse power at half that at which the machine is scheduled, it will be found more than the actual power used in most cases, the exception being such self-feeding machines as planer and sticker. However, on an average this will work out satisfactorily, and if electric power is used, this can be "checked up" on the meter. The estimated horse power used by each machine is the figure from which to get the power cost.

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Machine work is easily separated from the other items on the time card by noting the time value when a machine number is entered opposite. Time used in tailing machines must not be overlooked in this. Cabinet work, fitting, up-

EXPLANATIONS.

1. Rough stock from stock bill.
2. Include with this, all items which do not belong to 1 and 3.
4. Power can be figured from time sheet. Reduce to H. P. hours for each motor and figure at price per hour.
10. Labor involved in elevating and moving stock and repair work. Setting up of machines is entered in 5.
11. Add time taken for 5, 6, 7, 8, 9 and 10. Reduce to 7 hour days. Multiply by factor given by Instructor.
12. Figure as in 11. Multiply by factor given by Instructor

The Explanations Printed on the Reverse Side.

holstering and finishing are self-explanatory. Unproductive labor is explained on the reverse of the cost card.

Each article produced must bear its share of office and administrative expense. In a factory this would include salaries of officials and wages of foremen; in school work this naturally would be changed to salary of instructor and assistants and cost of office supplies. This is practically a constant cost, and can be figured as such. Determined by class and instructor at the beginning of the year, the result is used throughout the term. This result or factor to be used is the added salaries, etc., divided by the number of work days in the years and again by the number of workmen. If this expense amounts to $2,000 per year, the work days 200 and the number of pupils per day 50, the share each workman's day would bear is $2,000 divided by 200 divided by 50, making 20 cents. This, then, would be the factor mentioned under explanations for item number 11. Notice that the fifty pupils would be the average number accommodated in the shop at one time, not the total enrollment of all classes.

In figuring depreciation, one should estimate the number of years a machine will probably be of service, and divide the cost of equipment by this; subtracting, first, any value machines would have when discarded. A machine should give service longer in school work than in a factory, as it is seldom in continuous use. By inquiring of factory superintendents one can, however, approximate the average life of equipment. Suppose the equipment cost $3,500 and would be worth $500 at the end of twenty years. The depre-

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ciation would be five per cent. of $3,000, or $150 per year.

The interest would be figured on this investment and rent added, or instead of rent, depreciation, interest and taxes could be figured for the building occupied. The result should be practicaly the same. If the rent of a shop-room can be estimated at $100 for ten months, and the interest at five per cent. on the $3,500 equipment is $175, the total is $275 per year. Adding this to the $150 depreciation on machines, it gives $425 per year for the approximate expense of depreciation and interest, excluding taxes on the $3,500 equipment and the cost of any necessary repairs on machines, which cannot be made by the workman. Strictly speaking, such costs as band-saw blades, new knives, etc., should be added to the depreciation account, but owing to the fact that this expense is unknown until the end of the year, it is, perhaps, better to disregard it.

After the yearly depreciation and interest is found, it must be divided by the work days and by the number of workmen as in "office expense." In the case given, this would be $425 divided by 200 divided by 50, which is $.042. Four and two-tenths cents, therefore, would be the proportion of daily expense each workman would bear. The large part of this overhead burden is accumulated in the machine department, as the figures show.

The per cents. of cost for material and for the different branches of the work are figured from the total. Emphasis should be placed upon the cost of unproductive labor, and the constant expense of items 11 and 12. The fact that the workman's proportionate burden for the two items decreases in inverse ratio to the number of hours the plant is in use and the number of men advantageously employed, should be clearly set forth.

The record on the right of the cost card should be filled out as indicated. After finding the total cost of, say, three china cabinets, the average cost of one should be given and to this a suitable profit should be added to obtain an idea of factory selling price. Fifteen per cent. is often used as this profit. In schools where the boy receives his product, the cost of material is of importance, as this is the charge usually made.

That accurate cost keeping is considered by some "a nuisance" goes without saying. Many do not see the need

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of keeping a record of materials used. It is admittedly another exercise for the instructor, and its success or failure depends upon him. Taken in the sense of shop mathematics, however, it should not prove burdensome, and after being installed in the school shop it is found that the boys take pleasure in figuring the problems of which they are the vital part.

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TIMBER

ITS GROWTH AND DEFECTS

From a study of the growth of trees, we learn that in the spring of the year, the roots, by means of delicate root-hairs, absorb water containing mineral substances from the earth, which passes upwards through what is called the medullary sheath, which is composed of spiral vessels. The moisture consists chiefly of oxygen, and is generally known as sap. It is conveyed into the leaf-buds and together with other aids (light, etc.), forms the leaves on the tree which give off moisture, and absorb carbon in the form of carbonic acid gas from the atmosphere. In the autumn the sap in an altered state (thickened) passes down the tree between the bark and wood, thus assisting to form the annual ring. Some of the sap also fills up the pith or heart wood, which becomes denser and harder, and eventually ceases to grow. As a rule the age of a tree can be ascertained by the number of concentric circles seen on the end section. These are known as the annual rings, the light part being the spring layer and the darker and denser part the autumn layer. Sometimes, when the autumn is warm and moist, the tree will produce a second ring. The lines that radiate from the central pith, or medulla, are called the medullary rays and occur in all woods, but are not always visible. They are very pronounced in oak and beech.

In oak the medullary rays are the white layers, which make the figure or silver grain. Warm, sunny places, and dry elevated lands produce the heaviest, hardest, and strongest timber. In every stage of their growth, trees are liable to mischances from defects of soil and climate, accident, or the attacks of insects, animals or fungi. Some of these have a permanent and injurious effect on the wood. The most common mechanical defects are cup or ring shake, star shake, heart shake, and upsetts.

Fig. 1 (p. 17) illustrates the normal growth of timber.

CUP SHAKE (Fig. 2) is found mostly in tropical trees, and is attributed to unequal growth and the swaying to and

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fro in strong winds, causing the tree to bend, consequently tearing one layer from another.

STAR SHAKE (Fig. 3) is the result of the action of frost or sun. In cases where the clefts have extended to the circumference and are overgrown with bark, their presence is indicated by ridges or ribs in the bark.

HEART SHAKE (Fig. 4) is the most common defect, and occurs in almost every kind of timber, being generally the result of old age, causing the old heart layers to contract.

UPSETTS (Fig. 5). This is a cross fracture, and is difficult to detect until the tree is in process of conversion.

Another class of malformation of considerable interest to the timber dealer is the gnarled and warty excrescences known as burrs. These are sometimes due to mechanical injury, and in other cases to the attacks of certain insects which produce the swelling. It consists of a number of adventitious buds capable of growing in thickness and putting on wood, but insufficiently nourished to grow in length. In course of years, they may grow several feet across, the wood being very irregular, and, owing to its slowness of formation, very dense. The cross section of these bud axes, as in the "birdseye" variety of hard maples, yew, walnut, and oak furnish the beautiful burr veneers. Brown oak is discolored through being in a state of partial decay.

SHRINKAGE AND CONVERSION

The sapwood shrinks more readily than the heartwoods because it is not so dense and contains more moisture, thus the nearer a board is to the sapwood the more it will shrink. (See Fig. 6.)

The outside boards curl from the heart (Fig. 7), as the outer or sap rings contract.

In converting timber into planks or boards, the shrinkage and warping depend on the position in the tree they are cut from, and the variety of grain is also greatly affected by this. Thus, in converting oak by cutting in a certain manner, we get wainscot or figured oak. To obtain the best figure the boards have to be cut in a line as near as possible parallel to the medullary rays. Fig. 8 shows different ways of doing this; a comparison of the sketches of wainscot and plain oak will prove how greatly the beauty of the wood is enhanced by intelligent conversion into boards. Austrian and Russian oak is generally cut for the

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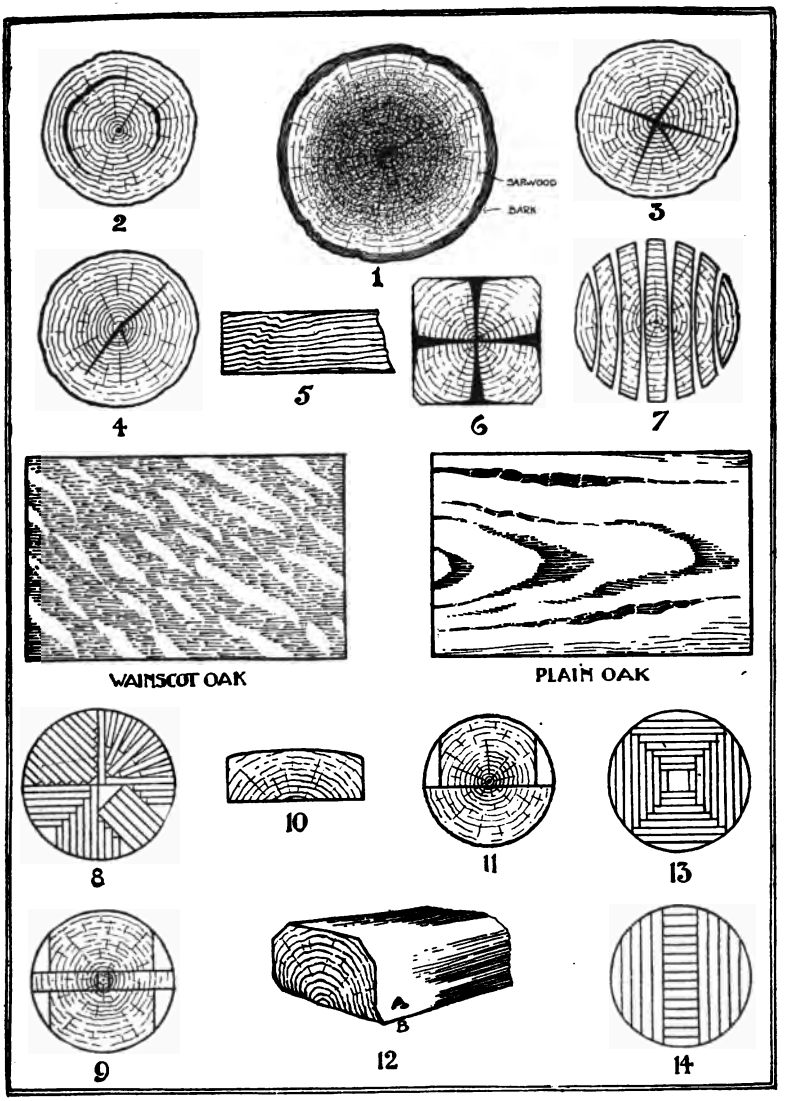

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English market in flitched logs (Fig. 9), that is, a 3-inch plank is cut out of the center, which, when the pith has been cut out make two smaller figured planks; the sappy edges are then cut off. Some shippers make their billets wide and shallow (Fig. 10). These yield a quantity of very narrow boards, many of which are without figure, as much of the wood is cut across the medullary rays; others, in order to give their wood a fictitious depth, make the billets as shown (Fig. 11), instead of splitting the logs fairly down the heart; then, to hide the heart, the end of the billet is "snaped" (Fig. 12), the wood lying between A and B has the heart running through it, and the wood B is devoid of figure. Buyers should therefore avoid wainscot billets with "snaped" ends.

Fig. 13 shows the method of cutting pitch pine into planks or any wood that depends on the annual rings for the figure. Slash or bastard cut is the term applied to timber cut as Fig. 14. This method is used for cutting plain oak, and when wide boards are desired.

Selection and Measuring

The selection of timber requires some experience, but the average man with a certain knowledge of his requirements should be able to select suitable stuff. The quality and figure of wood in the rough, is somewhat difficult to detect, therefore, until experienced, it is best to deal always with the merchants of good repute. A keen salesman soon detects lack of knowledge in a customer, but by paying a fair price and dealing with first-class people, the buyer should be able to rely on getting value for his money. Cheap hardwoods for high-class work are to be avoided, as the small difference in cost is soon lost in waste, extra labor in cleaning up and polishing.

By far the larger proportion of hardwoods, which are used in cabinet making, are put on the market in the form of boards and planks sawn from ⅜ inch thick up to 1¾ inches thick in hardwood, and 2 inches in soft wood, and sold by the foot super for 1 inch thick and under, and per foot super as 1 inch thick and over. Some varieties are sold by the foot cube.

Hardwood Logs at per Cubic Contents

The measurements taken in calculating the contents are

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the extreme length in feet and parts of a foot, this is multiplied by the average width in inches over all (reckoning in half the wane, if there is any) and then divided by twelve, the result being superficial feet. It is only with considerable practice that any person can board measure quickly, but there is on the market a measuring rule which, when laid across the width of a board of known length, does all the multiplying and dividing, giving the result at a glance; the range of this rule permits of its being used for measuring timber up to 36 inches wide and from 9 feet to 19 feet long. When specifying the thickness of wood in ordering, it must be remembered that it does not bear up to its nominal thickness, thus 1 inch stuff will not measure more than 7/8 inch, the saw kerf being taken out of it. The age and condition of wood can be ascertained if a short piece is cross-cut from the end, then the state of the sawdust can be observed, if dry and powdery, or whether inclined to cling together, also after a little experience the smell of such fresh cut wood is quite noticeable, especially in oak.

Boards which are round or warped may be brought level either by causing the hollow side to swell or the convex side to shrink. The shrinking of the convex side may be effected by exposing it to the warmth of an iron plate or fire. A small amount of heat will soon draw it flat. The hollow side may be swelled by damping it or placing a little wet sawdust on the hollow part for a short time. If the hollow side is placed on a cold stone floor this will also prove effectual.

Market Forms of Timber

(In the following definitions are found, first, the English, or Continental, terms and their explanations and, second, the equivalent terms and explanations as commonly used in the United States.)

A *log* is a trunk felled and lopped. (U. S.—A log is one section of a tree that has been cross cut into standard lengths.)

A *balk* is the log squared by axe or saw. (U. S.—Not used in this country. The equivalent terms here would be square or hewn timber.)

A *plank* in hardwood is any cut stuff upwards of 9 inches wide and 1¾ inches thick. In soft wood upwards of 10 inches wide and 2 inches thick. (In U. S. a plank is

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any board 2 inches and up in thickness and 8 inches and up wide.)

A deal is over 2¼ inches thick and less than 10 inches wide. (In U. S. a deal is a 3 or 4 inch plank or flitch.)

A *batten* is between 1½ and 2 inches thick and less than 9 inches wide. (In U. S. the use of the word "batten" is confined to pine. It is a strip 1 inch or less in thickness and 6 inches or less wide.)

A *board* is less than 2 inches thick and over 5 inches wide. (In U. S. a board is generally 1 inch, 1¼ inch, 1½ inch or 1¾ inches thick and over 6 inches wide; usually 1 x 7 inches and wider.)

Dimension square stuff. Between 5 inches by 5 inches and 9 inches by 9 inches. (In U. S. it would be termed square dimension.)

Whole timber. Uncut balks. (In U. S. this means full tree lengths.)

A *flitch.* One-half of a balk cut in two lengthways. (In U. S. a flitch is 3, 4, 5 or 6 inches thick, "good quality," and as wide as the log will permit it to be made. The term is used only in the veneer industry.)

Quartering, 3 inches by 3 inches to 4¼ inches by 4 inches. (In U. S. this is called small dimension stock, like chair stock. It is cut from 1 x 1 to 4 x 4 inches. As a rule is in baluster or handle lengths.)

A square of flooring and matching, 100 feet superficial. (In U. S. the same term is used.)

Scantling. Miscellaneous cut stuff. (In U. S. it refers to dimension in building material, more particularly 2 by 4's in the standard lengths.)

A *hundred of deals* = 120. (In U. S. not used.)

A *load of timber* = 50 cubic feet. (In U. S. this means 600 board feet.)

A *float of timber* = 18 loads. (In U. S. this would mean 10,800 board feet, or about a carload.)

Ends, pieces of deals, planks and battens, cut off in the conversion of the latter to standard lengths. (In U. S. we call these cuttings, or trimming blocks.)

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TIMBER CALCULATIONS.

ENGLISH AND AMERICAN METHOD.

Comment by the American Publishers.—The following chapter is here printed as it appears in the English edition of the work. American readers will find it of interest only as disclosing the methods still in vogue in England. It can have no application to methods pursued in measuring or calculating timber in the United States, but as this work may have larger circulation than the boundaries of the United States, the chapter is printed as originally written by Mr. Rudd. It is supplemented, however, by an explanation, etc., by an American writer familiar with the practices of American lumbermen.

One of the most frequent pieces of wood the contents of which need to be discovered by the cabinet-maker is the pine plank, which is frequently bought at so much "per standard." A "standard" consists of 120 pieces 12 ft. by 1½ in. by 11 in.; but it is more usually looked upon as 60 pieces 12 ft. by 3 in. by 11 in. A very simple way of finding the cost per plank is to take the price per standard in pounds and multiply it by four. For instance, if a standard of pine is 12 pounds 10 shillings, *i. e.*, 12½ pounds, we find that multiplied by 4 it costs 50 pence; therefore, one piece 12 ft. by 3 in. by 11 in. will cost 4 shillings 2 pence.

If a parcel of pine consists of a number of pieces of various sizes, it will be well to bring the whole lot down to inches, and then divide by three, then by eleven, and then by twelve, which will give the result in 12 ft. by 3 in. by 11 in. For instance, take a parcel consisting of 60 pieces of 12 ft. by 3 in. by 9 in., we multiply the 60 by 12, the result by 3, and then again by 9. This gives us the figures of 19,440. Taking the next line of the specification as being 30 pieces of 6 ft. by 3 in. by 9 in. and carrying it out in the same way, gives a total of 4,860; and the third line of the specification, which we will assume consists of 30 pieces of 9 ft. by 3 in. by 6 in., gives another total of 4,860, and the fourth and last line on our specification is 60 pieces of 12 ft. by 1½ in. by 6 in., giving a figure of 6,480. These four totals added together make 35,640. Having this divided by 3, 11 and 12 successively, we get the result of 90 pieces of 12 ft. by 3 in. by 11 in., *i. e.*, 1½ standards.

Hardwood boards, such as American lumber, are usually

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sold at per foot superficial, *i. e.*, a board 12 ft. long by 12 in. wide contains 12 ft. superficial and one 12 ft. long and 9 in. wide, 9 ft. superficial. It will be observed that the rule is to take the length in feet and multiply it by the width in inches, the resulting figure divided by 12 giving the superficial contents. A board 8 ft. long and 18 in. wide will be found, for instance, to contain 12 ft. superficial.

A custom of the trade is to sell everything above 1 in. thickness at per foot superficial as 1 in., *i. e.*, a board 1¼ in. mahogany containing 12 ft. is reckoned as 15 ft. of 1 in.; a plank of 2 in. containing 12 ft. is reckoned as 24 ft. of 1 in.

In buying solid logs of timber, it is well to know by what kind of measure they are being sold; caliper measure being that which is worse for the buyers, because in caliper measure the extreme measurements are taken, irrespective of the fact that the log may be octagonal or even round. The result of this kind of measure is that a good portion of the surrounding atmosphere is measured up and sold to the buyer at the price of good, solid timber.

Round logs, particularly home-grown timber, are generally sold by string measure, a tape measure being put round the trunk of the tree at different places so as to get a fair average measurement, and this divided by 4, the result being called "quarter girth." The quarter girth in inches multiplied by itself and then by the length of the tree in feet and then divided by 144 gives the cubic contents, *i. e.*, a log 48 in. round and 12 ft. long will give 12 in. as quarter girth and that multiplied by itself, *i. e.*, 12 in., and then multiplied by the length and divided by 144 will give the result of 12 cubic feet.

Most mahogany logs are bought and sold under what is called "Liverpool measure" at per foot superficial of inch, and this kind of measure is very advantageous from the buyer's point of view, a gain of 20 per cent. usually resulting to him.

Trade and Actual Sizes of Timber Compared

There is a difference between both width and thickness of prepared timber as ordered and supplied. This is accounted for by the amount of wood removed by the planing machine, and in tongued boarding the width of the tongue has also to be accounted for. This is the custom of the trade. The following table shows the loss and, also,

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in another column tells how many feet of the nominal size are sold as a square, while, as a rule, a much larger quantity is needed to actually cover a square of 100 feet superficial;

FLOORING, MATCHING, ETC.

TRADE SIZE			ACTUAL SIZE		
Width so-called. Inches	No. of running feet sold as a square	Actual width straight joint. Inches	No. of running feet in a square	Ploughed and tongued holds this width only. Inches	No. of running feet in a square
9	140	8 11/16	139	8½	142
8	160	7 11/16	157	7½	160
7½	170	7 3/16	167	7	172
7	180	6 11/16	180	6½	185
6¾	185	6 7/16	188	6¼	192
6½	190	6 3/16	194	6	200
6¼	195	5 15/16	203	5¾	209
6	200	5 11/16	211	5½	219
5¾	210	5 7/16	221	5¼	229
5½	220	5 3/16	232	5	240
5¼	230	4 15/16	245	4¾	253
5	240	4 11/16	256	4½	267
4½	270	4 3/16	287	4	300
4	300	3 11/16	326	3½	344
3½	350	3 3/16	377	3	400
3	400	2 11/16	447	2½	480

It is also necessary to remember that in the thickness of boards 1¼ in. flooring or matching finishes 1 1/16 in.; 1 in. finishes 7/8 in.; 7/8 in. finishes 11/16 in.; ¾ in. finishes 9/16 in.; ⅝ in. finishes 7/16 in.; ½ in. finishes 5/16 in.

AMERICAN COMMENT.

BY L. E. FULLER,

Associate Editor Lumber World-Review of Chicago.

The chapter as printed can have little applicability in this country. It is customary for our exporters to make out all their bills by United States measurement and in United States money and the bank on this side, or its correspondent abroad who makes the collection does the necessary figuring to express the amounts in the foreign measurements and moneys.

This works both ways, as nearly all the cable codes are expressed in American terms and money. The foreign buyer uses our language and trade expressions when ordering, whether by cable or mail.

As to the methods used in measuring the contents of logs, the instructions given are superfluous at present, in this country at least, as the trade here uses the log stick,

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which is similar to the lumber rule used in the measurement of lumber.

In calculating the contents of logs where the measurements are known, there are three standard rules or systems of measurement used, namely, the Doyle, the Scribner and the Scribner-Doyle, the latter being a combination of the other two.

However, it might be of interest to some people to know how the foreigners, or some of them, at least, cling to methods of measurement and computation that are obsolete in this country.

With regard to the "Trade and Actual Sizes of Timber Compared," it is a very simple thing in this country. A 2 x 4 in. stick of piece stuff is actually 1¾ x 3¾ in. S1S and 1E, or should be, but where the wood is particularly strong, as with long leaf yellow pine, for instance, the actual dimension is sometimes 1⅝ x 3⅝ in., dressed four sides, there being an allowance made for both saw kerf and dressing. The usual allowance in inch stuff for dressing is 3/16 inch. Sometimes where there is a heavy freight rate, the shipper will make his stock thinner and the customer will accept it thus, knowing there is a good reason for so doing.

With regard to allowances made for tonguing and grooving, the universal custom, as made by the association and approved by the trade, is to measure the flooring, ceiling or partition according to the width of the rough strip from which it was made. A piece of 2¼ in. face flooring is measured 3 inch, a piece of 5¼ inch flooring being measured as 6 inch and so on, the allowance for tonguing and grooving being in all cases ¾ inch.

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THE SEASONING OF TIMBER

THE DIFFERENT PROCESSES

Timber in its green state contains a large proportion of water, and the importance of proper seasoning and drying cannot be over-estimated, as the effect of an excess of moisture is bad from every standpoint. The strength of wood is vitally affected if it is not properly dried, and it is also liable to shrink, swell, warp and split. During the process of seasoning, a natural shrinkage takes place, but much can be done by equal and regular drying and stacking to avoid shakes and warpage; soft woods naturally hold more moisture than the harder varieties.

Natural Drying

There are two methods of seasoning woods, natural and artificial. The natural method takes very much longer than the artificial one, and is now seldom resorted to, but nevertheless, a few notes as to the process may not be out of place. Before the logs are cut up or converted into planks, they are exposed to the action of the weather for some time, thus obtaining a certain amount of seasoning. When converted, the material is stacked in covered sheds which are open at the sides. Ashes or some material of a similar nature should be laid in the timber yard to prevent any vegetation growing which would tend to harbor moisture, and care should be taken to bed the wood level, placing the boards in such a position that they are exposed to free currents of air. No artificial warmth is used, and the timber should be protected from the direct rays of the sun. If in the form of boards, these are piled up about a foot from the ground with skids between each, and weighted so that they shall not warp. It is usual to nail strips of hoop iron or wood on to the ends of hardwood planks to prevent them from splitting. A coat or two of thick paint is perhaps better, as if painted, the wood can shrink without splitting, and by the other method there is a tendency for the nails to hold the wood, causing it to split. Experience shows that the stacking of timber vertically, or at an angle tends to produce unequal drying.

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Pitch pine skids should be used in stacking, as they will not stain such woods as sycamore and mahogany when damp. When dried in this natural way, soft woods require two to three years to season, and hard woods, to be perfectly seasoned, from six to nine years. It is obvious that the smaller the timber is the sooner it is ready for use, and the less injury it suffers from shakes and shrinkage; moisture is retained in the center of large stuff for a long period when dried in this natural manner. If logs are placed in a stream of running water with their butt ends towards the flow, the time required for seasoning is shortened. The effect of this treatment is to displace the sap with water, which is more easily evaporated. It is obvious that this is more effective with open-grained than close-grained woods.

The above old-fashioned method of drying necessitates the investment of a large capital which lies quite idle while the timber is seasoning, and at the same time, considerable outlay is occasioned by the purchase or rental of large timber yards. There can be no doubt, however, that timber dried naturally does not show the same tendency to shrink and swell, under varying atmospheric conditions, as lumber rapidly dried by artificial means.

Mechanical Drying

Timber which is dried mechanically should not be immediately employed by the cabinet maker, but allowed to rest for a week or two to settle or re-absorb a small percentage of moisture from the atmosphere. The aim of the engineer in mechanical drying is the artificial production of the best possible conditions of temperature, humidity and circulation of air in enclosed rooms or kilns so as to effect the rapid desiccation of the material. The increase of temperature is compensated for by the increased humidity of the air, and the moisture, as it is evaporated, is carried away by the air, which not only transmits the heat for evaporation, but also acts as a sponge to carry away the moisture.

We have already discussed some of the advantages of mechanical drying, such as avoiding the keeping of capital idle for years, and the saving of space, but another advantage is that by careful mechanical treatment, the lumber can be dried with less wastage than if left exposed to the

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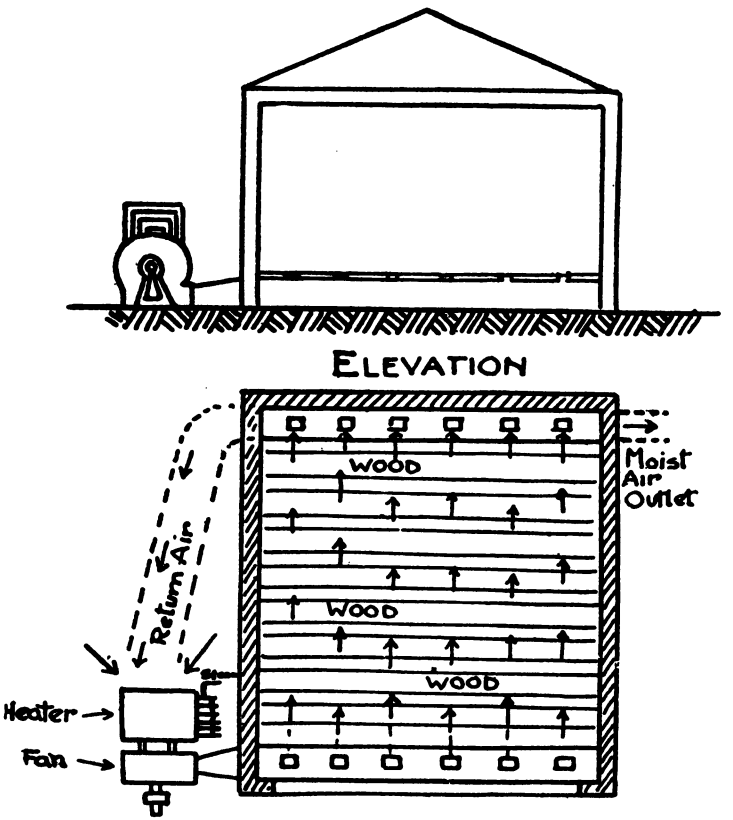
elements in natural drying. Timber baked or dried in an unscientific kiln is, of course, inferior to natural dried wood, as it will get cracked.

If the ideal conditions of temperature, humidity and air circulation are maintained, it is possible to obtain kiln dried wood which is satisfactory in quality and strength, and with



SMALL DRYER WITH ONE ROOM

less cracks than timber dried naturally. A drying kiln, to give satisfactory results, must be capable of ease of regulation, not only of temperature and volume, but also of the humidity of the air. The air is circulated by means of one or two centrifugal fans, and the necessary heat is generally produced by means of a steam heater, the air being blown by the fan through a battery of steam pipes. The humidity

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control is obtained by using a greater or lesser proportion of return air from the kiln. It follows then, that if there are several kilns working simultaneously, but with different materials, it is necessary to have a separate fan for handling the moist air. When commencing the drying of a charge of timber, the moist air alone is used, otherwise, if it did not actually crack, the surface would become case hardened, that is to say, the outside pores are closed before the heat has penetrated to the interior of the wood. There is, therefore, no outlet for the moisture, hence the outer layers shrink away from the interior, causing shakes. By proper handling, and with a suitably arranged kiln this can, however, be avoided. Frequently the wood is steamed before passing it into the drying rooms; this facilitates the drying process, but if steamed to excess the strength of the wood is somewhat affected, and it is really preferable to take the green wood and dry it out with moist air. The temperature employed varies with the kind of material and also with its condition as to dryness when the kiln is charged. All kinds of wood start drying at a low temperature, so as to slowly warm up the center of the material; the temperature is then gradually increased, decreasing the humidity at the same time. Soft woods generally stand a temperature up to about 200 degrees F.; hardwoods up to about 100 degrees to 120 degrees F.

The Progressive System

In some woodworking concerns, there are large quantities of pieces of wood of the same size and thickness to be seasoned. In this case the progressive system is sometimes employed. The material is piled on trucks and passed through tunnels sloped downwards, to facilitate the movement of the trolleys, which move periodically against a current of hot air. This automatically gives the fresh green wood an atmosphere of moist, cool air, the wood meeting hotter and drier air as it progresses through the kiln, until finally it is taken out thoroughly seasoned at the hot end.

The Compartment Kiln

Where different sizes and kinds of wood are treated the compartment kiln is used. In this, there are rooms with underground or side air ducts, supplied with warm or

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moist air, with one or more fans working in conjunction with steam heaters. There are three main ducts carrying warm, cold and moist air respectively. By means of cross collector ducts with mixing dampers, the supply of any proportion of these three kinds of air independently to any kiln can be arranged; consequently, it is possible to have utterly different conditions prevailing in the various kilns. No. 1 may be drying thin, soft whitewood at a high temperature with dry air, the second may be starting with thick, hard wood with moist air only, and so forth. The outlets from the kilns are all connected up to a main duct which leads to the moist air fan, and the air which is not needed for recirculation is discharged to atmosphere.

The kind of fan mostly used for drying logs is of the centrifugal type, either drawing through or blowing, through the heater according to which is most convenient for the plant. The heater is made up of steel pipes in ∩ form and the lower ends of these pipes are firmly screwed into cast-iron bases. The vertical steam pipes are so arranged that air passing between them has the best possible chance of coming into contact with the whole surface of the tubes, without undue resistance being offered to its passage.

Drying kilns are best constructed of brick with double walls and air space between. The ducts also should be carefully made so as to avoid the possibility of water entering them. These should have double walls for the hot air ducts. The best type of door is the lift-up or guillotine door, but where head room is not available, sliding doors can be used. For the construction of these, particularly dry wood should be employed, and they should always be made double with an air space between them.

Where it is necessary to dry large quantities of timber, it is often advisable to pile it on cars and wheel the whole into the kiln. In such cases suitable tracks are laid in the compartments.

Humidity can be estimated by wet and dry bulb thermometers. Hardwood 1 inch thick will take from 5 to 16 days to season, according to the state of the timber before it enters the kiln.

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DRAUGHTING FOR WOODWORKERS

SOME OF THE FUNDAMENTALS

At the outset let us make it plain that this is not a chapter for draughtsmen and it does not deal with the making of pencil, pen and ink, or water-color sketches of furniture. The reason for this is obvious. At the present time specialization has, rightly or wrongly, in almost every instance divided the cabinet maker and the draughtsman—the cabinet maker is busy in the workshop and the draughtsman in the studio. It is not our intention to consider at any length the advisability of this, but the practical cabinet maker is sometimes aware that the draughtsman embodies detail, which, had he a closer knowledge of actual working conditions, he would probably not have included; and on the other hand, designers often complain that many cabinet makers do not understand their drawings sufficiently to carry out their ideas faithfully. It is an advantage to any man engaged in the mechanical crafts to be able to express his ideas with ease on paper; yet the instances where this is the case are, unfortunately, all too rare. This short explanation is necessary to make it clear that this article does not deal with draughting for designers but with that measure of draughtsmanship which is necessary for every cabinet maker in the carrying on of his craft.

When making full-size working drawings the sections of mouldings, plan, etc., should be given, but care must be taken to omit unnecessary detail because this serves to complicate rather than make things clear. Often a rod or skid takes the place of full-size drawings, and if the work is large and complicated it is necessary to transfer the chief parts to a skid or rod, as paper stretches, and measurements taken at different times vary.

Freehand drawing is largely a question of temperament and practice, but geometrical drawing can be acquired by any cabinet maker who cares to make a study of the few simple directions given hereafter. The average craftsman hesitates at the idea of making a drawing of an article of furniture, but, provided he has a good knowledge of con-

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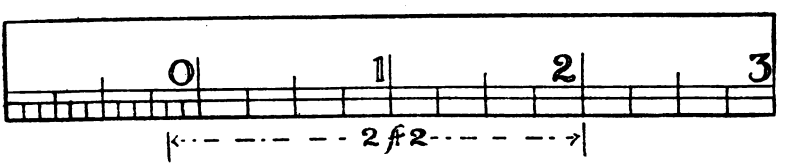
struction, he should with a little practice be able to make drawings of any simple piece of work, not embodying elaborate shaped work, requiring for its execution the practiced hand of a draughtsman. The first thing to master is the idea of an elevational scale drawing. Although to the maker a full size drawing is of more value than a scale drawing to work to, if the work is at all complicated, the time given up to the making of a scale sketch is nevertheless well spent, because it should obviate any glaring error in proportion.

The chief things to be remembered in designing are utility and construction, the ornament being the last consideration. Whatever form the decoration may take it must be remembered that a large amount of ornament does not make an ill-proportioned and badly-constructed article good. Design does not consist in the quantity of ornament. It is better to err on the side of plainness than to overload the article with meaningless decoration.

Scale drawing is resorted to to do away with the necessity for making every drawing full size. Let us assume that the maker has in his mind an idea for a sideboard back but that he is not sure whether it will look too high

ONE INCH TO THE FOOT

when placed upon the under part. The making of a full-size drawing to ascertain this would necessitate much time and trouble and even then would not answer the purpose as well as a scale drawing. In making a sketch to scale the article is drawn smaller, every foot of actual measurement being represented by some smaller unit in the sketch, say 1 inch or 1½ inch, the simplest to use is the 1½ inch scale, in this case every foot in the article itself is represented by 1½ inches in the scale sketch and every inch in the article itself is represented by ⅛ inch in the scale. The 1½ inch scale is the simplest because if a smaller scale than this is used, the details are confused and difficult to draw accurately. Time is saved if a separate rule is made for each scale, thus obviating the necessity for turning

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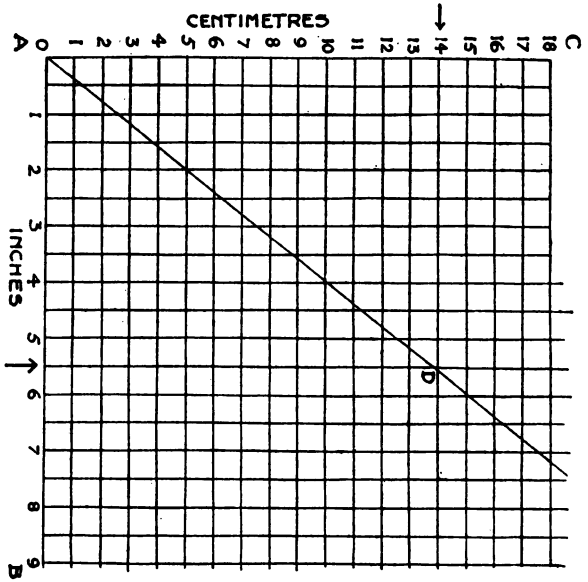
over a scale rule to find the one required, as the various scales given are somewhat confusing. A 1 inch scale is shown full size on page 32.

Sketches from abroad are sometimes marked with metric sizes which are very perplexing to a cabinet maker who is used to feet and inches, and the following method of converting centimetres into inches may be of service.

This scale is constructed as follows:

Draw a line A B and from A raise a perpendicular A C, and mark off on each of these lines a number of equal divisions of convenient length, and through these divisions draw lines parallel to A B and A C. On A B number each



second division as shown and mark these inches. On A C number every division and mark these centimetres. Find the point D, where the parallels passing through 5½ inches and 14 centimetres cross each other. Through the points A and D draw a diagonal line. It is now easy to find the English equivalent of a size given in centimetres, *e. g.*, from the point 5 go across at right angles to the diagonal A D, and there drop vertically to the line A B, and the equivalent will be found in English measure, namely, 2 inches.

After the general proportions and form of the article are determined, the main dimensions must be considered. Naturally, the beginner finds difficulty in determining the

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heights, depths and thicknesses of the component parts and this knowledge can only be obtained through actual experience. It may be useful, however, to enumerate a list of sizes, but it must be definitely understood that these are average sizes and there is no need to slavishly adhere to them, as certain pieces of furniture vary somewhat with the conditions under which they are to be used. It is important to get sizes right in furniture from the fact that it is used in conjunction with the human body and the comfort of those using the furniture is *directly* affected by any error. A dining table which is too low, a writing table which is too high, a chair seat which is so low that a heavy person has difficulty in rising from it, a chair which gives no adequate support for the back or the knee hole of a writing table which is too narrow for comfort are instances in point.

The Average Sizes of Furniture

Wardrobes

Case Sizes	Width	Depth
	3 ft.	1 ft. 8 in.
	3 ft. 6 in.	1 ft. 8 in.
	4 ft.	1 ft. 9 in.
	4 ft. 6 in.	1 ft. 10 in.
	5 ft.	1 ft. 10 in.

Height of wardrobes vary from 6 feet, 8 inches, to 7 feet, exclusive of top ornamentation.

Dressers

Tops	Width	Depth
	3 ft. 6 in.	1 ft. 10 in.
	3 ft. 9 in.	1 ft. 10 in.
	4 ft.	1 ft. 11 in.
	4 ft. 6 in.	2 ft. 1 in.

Height from floor to top, about 2 feet, 10 inches.

Chiffoniers

Tops	Width	Depth
	2 ft. 6 in.	1 ft. 8 in.
	2 ft. 10 in.	1 ft. 8 in.
	3 ft.	1 ft. 10 in.
	3 ft. 4 in.	1 ft. 11 in.
	3 ft. 6 in.	2 ft.

Height from floor to top, 3 feet, 6 inches to 4 feet.

Toilet Tables

Tops	Width	Depth
	2 ft. 8 in.	1 ft. 8 in.
	2 ft. 10 in.	1 ft. 8 in.
	3 ft. 2 in.	1 ft. 9 in.
	3 ft. 4 in.	1 ft. 9 in.
	3 ft. 6 in.	1 ft. 10 in.

Height from floor to top, 2 feet, 6 inches.

Commodes

Tops	Width	Depth
	2 ft. 8 in.	1 ft. 7 in.
	2 ft. 10 in.	1 ft. 8 in.

Height from floor to top, 2 feet, 3 inches.

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Sideboards

Tops	Width	Depth
	4 ft.	2 ft.
	4 ft. 6 in.	2 ft. 1 in.
	5 ft.	2 ft. 1 in.
	5 ft. 6 in.	2 ft. 1 in.
	6 ft.	2 ft. 2 in.

Height from floor to top, 3 feet to 3 feet, 6 inches.

Side Tables

Tops	Width	Depth
	3 ft.	1 ft. 7 in.
	3 ft. 2 in.	1 ft. 8 in.
	3 ft. 4 in.	1 ft. 10 in.
	3 ft. 9 in.	1 ft. 10 in.
	4 ft.	1 ft. 10 in.

Height from floor to top, 3 feet.

Dining Tables

Top	Length Extended
3 ft. 9 in. x 3 ft. 9 in.	6 ft. to 8 ft.
4 ft. x 4 ft.	6 ft. to 8 ft.
4 ft. 6 in. x 4 ft. 6 in.	6 ft. to 10 ft.
5 ft. x 5 ft.	8 ft. to 12 ft.

Height from floor to top, 2 feet, 4 inches.

China Closets

Width	Depth
3 ft.	1 ft. 2 in.
3 ft. 6 in.	1 ft. 3 in.
3 ft. 9 in.	1 ft. 3 in.
4 ft.	1 ft. 4 in.
4 ft. 6 in.	1 ft. 4 in.

Height from floor to top, 5 feet, to 5 feet, 6 inches.

Bookcases

Tops	Width	Depth
	2 ft. 6 in.	1 ft.
	3 ft. 6 in.	1 ft. 1 in.
	5 ft.	1 ft. 2 in.

Height from floor to top of case, 4 feet, 2 inches to 5 feet.

Writing Tables

Tops	Width	Depth
	3 ft. 2 in.	1 ft. 9 in.
	3 ft. 4 in.	1 ft. 10 in.
	3 ft. 6 in.	1 ft. 11 in.

Height from floor to top, 2 feet, 6 inches.

Hall Seats

Length, 3 feet, 6 inches to 6 feet.
Height of seat, 1 foot, 6 inches.
Depth of seat, from 1 foot, 6 inches to 1 foot, 8 inches.

Hall Tables

Tops	Width	Depth
	2 ft. 10 in.	1 ft. 6 in.
	3 ft. 2 in.	1 ft. 6 in.
	3 ft. 6 in.	1 ft. 7 in.

Height from floor to top, 2 feet, 8 inches to 2 feet, 10 inches.

Hall Chairs

Width, 1 foot, 6 inches (front of seat).
Depth, 1 foot, 5 inches (including back).
Height of seat, 1 foot, 6 inches.
N. B.—Backs of hall chairs are more upright than others, and the back rails may be straight, not curved.

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DINING CHAIRS

Width, 1 foot, 6 inches to 1 foot, 7 inches (front of seat).
Depth, 1 foot, 5½ inches (including back).
Height of seat, 1 foot, 6 inches.

CHAMBER CHAIRS

Width, 1 foot, 5 inches (front of seat).
Depth, 1 foot, 4 inches.
Height to top of seat, 1 foot, 5 inches.

MUSIC BENCH

Top, 1 foot, 5 inches by 3 feet, 2 inches (seats two players).
Height from floor to top of seat, 1 foot, 8 inches.

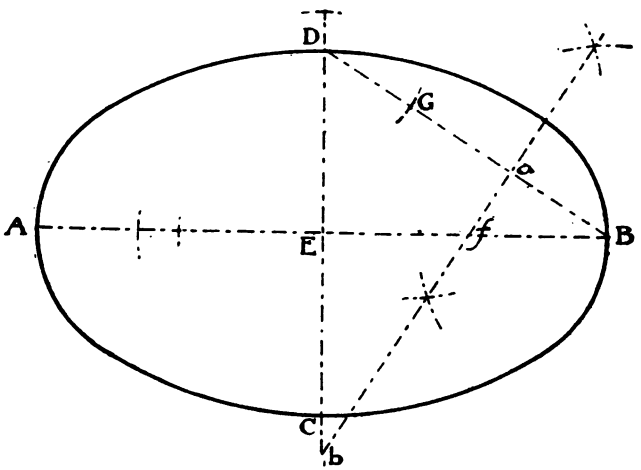
The depth of the chair from back to front varies with the height of the seat from the floor. The average rule is that the sum of the seat plus the height equals 35 inches.

The slope of the back of a chair without arms should not be more than a quarter of the depth of the seat.

In the case of a chair with arms one-third to one-half of the depth of seat is taken.

THE STRIKING OUT OF OVALS AND ELLIPSES

Having settled the question of average sizes, the workman is next confronted with setting out geometrical figures. The oval, for example, is a very frequent form in



cabinet making; toilet mirrors, tea trays, overmantels, and inlaid center pieces often taking this shape. There are many methods of drawing ovals but only few of these can be practically applied in the workshop, and only those will be considered therefore which can be struck out by mechanical aids.

TO CONSTRUCT AN OVAL WITH COMPASSES

AB is the length and CD the breadth of the desired oval, join BD and make GD equal to the difference between DE and AE. Halve BG and through the center point draw

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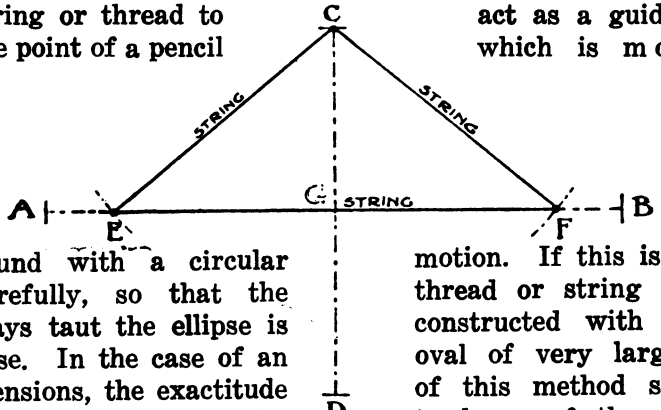
a b perpendicular to BG, intersecting EB in *f*, and EC (or EC produced) in *b*, *f* and *b* are the centers of the arcs, forming an oval.

To Construct an Oval with String and Nails

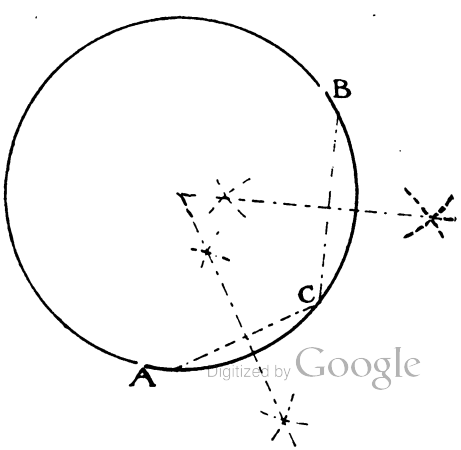
In the diagram, AB represents the length and CD the width of the oval. These two lines cut one another at G. With center C, and distance AG or GB as radius, strike off points E and F on the long axis of the oval. Nails should be driven in perpendicularly at E, F and C, then tie a piece of string (which should have been previously stretched) round the three points, remove the nail at C and allow the string or thread to act as a guide for the point of a pencil which is moved round with a circular motion. If this is done carefully, so that the thread or string is always taut the ellipse is constructed with great ease. In the case of an oval of very large dimensions, the exactitude of this method suffers somewhat owing to the tendency of the string to stretch, but for any ordinary work it answers quite satisfactorily. As a matter of fact where the string method can be employed, a much better line is obtained than by the use of compasses.



Circular Work

Circular work presents no difficulties except in instances where only part of a circle is given and it is necessary to find the center from which that part was struck.

Let AB be the portion of the circumference which is given; draw any two lines AC and CB, bisect them and through their centers draw lines perpendicular to them; the point



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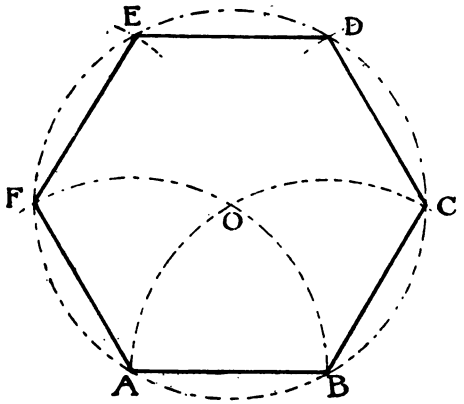
where these two lines meet is the center of the circle.

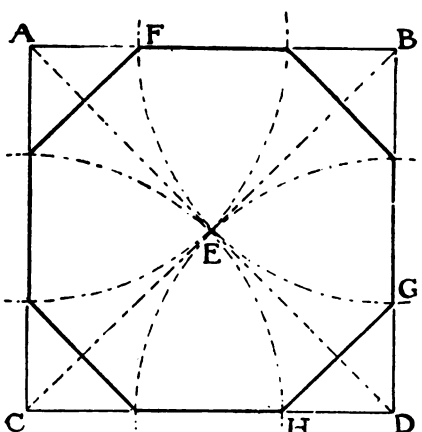
To Strike a Hexagon on a Given Straight Line AB.

With A as center and AB as radius, construct the arc BF; and with B as center and BA as radius, construct the arc AC, these intersect at O. With O as center and the same radius describe a complete circle. With F and C as centers and the same radius, cut the circle in E and D; join AF, FE, ED, DC and CB, and the hexagon is complete.



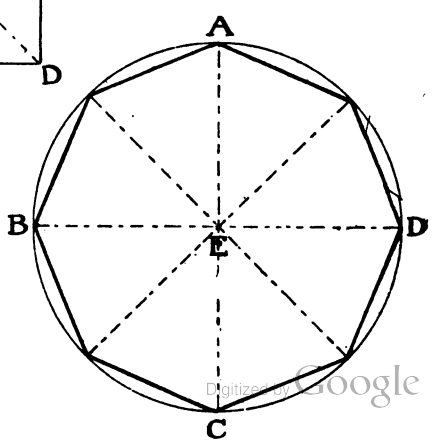
To Place an Octagon in a Given Square

Let ABCD be the square; draw diagonals cutting each other in E, then with center B and distance BE, describe a quadrant, cutting the square in F and G. Proceed similarly in each corner and the eight points of the octagon are obtained. Join these points and the octagon represents the largest eight-sided figure which a square will contain.



Supposing the square has 18 inch sides the octagon measured from the point F to the point H will be considerably more than 18 inches.

Provided it is required to construct an octagon which shall be



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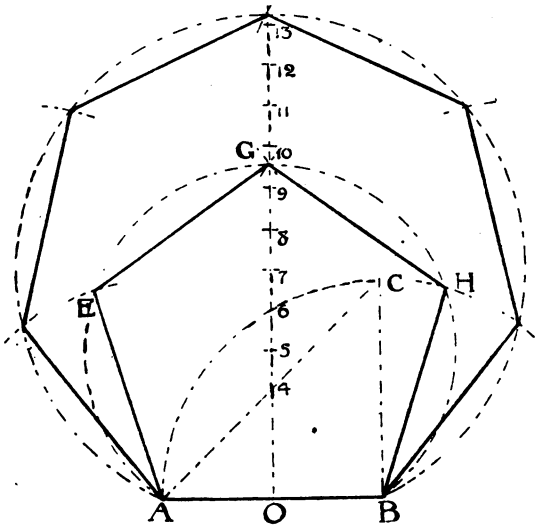
exactly 18 inches from F to H, then proceed as follows:

Describe the circle ABCD, 18 inches in diameter. Draw two diameters AC and BD at right angles to each other. Draw two other diameters exactly bisecting the four angles at the center, join the points of intersection of the diameters and the circumference and the octagon is complete.

To Describe any Regular Polygon

The cabinet maker sometimes finds it necessary to describe a figure with 5, 7, 8 or 9 sides, only one of which is given.



Let AB be the straight line which is given, and through the point B draw BC perpendicular and equal to AB; join CA. Bisect AB in O and raise another perpendicular at this point, cutting line AC at the point 4. With center B and radius BA describe the arc AC cutting the perpendicular at 6. Bisect the line 6—4 in 5. With distance 6—5 strike off 6—7, 7—8, 8—9, and so on.

Now supposing a five-sided figure is required with center 5 and distance 5A, describe a circle, and from the point A step off AE, EG, GH, and HB. If a seven-sided figure is required, take the center 7 and with distance 7A describe a circle, and then proceed as before, stepping off distance AB round the circumference of the circle.

To Inscribe any Regular Polygon in a Given Circle

Draw a diameter AB and divide it into as many equal parts as there are to be sides in the polygon (in this case seven). Number the divisions from either end. With A

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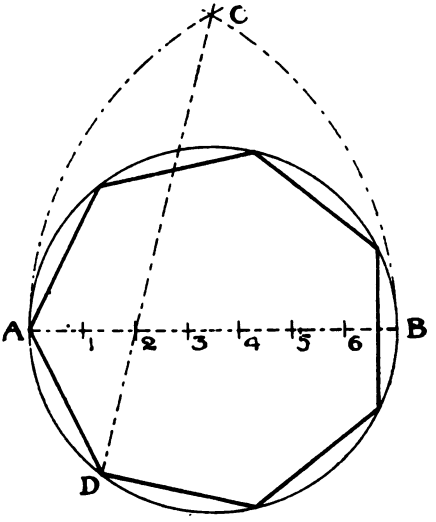
and B as centers and the diameter of the circle as radius, describe arcs intersecting in C. Draw a line through C and 2 and produce it to D. Then AD is one of the sides of the seven-sided figure required.



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THE TAKING OF MEASUREMENTS

FOR FITMENTS

It sometimes falls to the lot of the cabinet maker to pay a visit to a house at a distance to take measurements either for his own reference or for the use of a designer. It is essential that he should bring back all the information which will be required in estimating and getting out a scheme, otherwise a second journey will be necessary, entailing inconvenience and expense. In addition to the taking of the actual measurements, with which we shall deal below, there are many other details which he should observe and be able to report on, if necessary. A country house is frequently in an isolated position, and he should find out its distance from the nearest railway station, and also make a note of any extraordinary gradient in the highway likely to prove difficult of negotiation by a pantechnicon or motor-trolley. The roads in the neighborhood, and especially through the grounds, of a newly-built house are frequently in a soft, boggy condition, likely to cause great difficulties to heavy traffic. It is, therefore, unwise to deliver heavy loads of furniture likely to be damaged by jolting until the approaches to the house have been properly made.

It will be of service, if more than one room is to be panelled, to make a rough plan of the house, showing the relation of the various apartments to each other. It is also essential to find out which point of the compass the apartment to be furnished faces. Now let us take an individual room and see what sizes are absolutely necessary. At the outset we would draw special attention to a matter which is the most frequent cause of mistakes and consequent delay and loss of money, and that is the necessity of stating definitely whether the measurements taken are brick work sizes or plaster sizes. Particulars often have to be obtained while a house is still in course of construction, before the walls are plastered. The plaster on each wall is ¾ inch thick, the sizes of a room in the brickwork stage will therefore differ by 1½ inches from those of the same

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room when plastered. Then again, supposing the house is finished, care must be taken to state exactly whether the sizes on the plan are taken to the actual walls or to the skirting. Any such vague terms as "Door 3 feet 3 inches" wide should be studiously avoided, as in setting out the work full size subsequently the cabinet maker will want to know whether the 3 feet 3 inches refers to the lining, the stop, or the edges of the architrave moulding. The proper way is to draw a plan (it need not necessarily be to scale), as shown on page 43. Roughly jot down the position of the fireplace, window, door and other projections or recesses in the room, and give their exact width and depth or projection; also give the projections of the architrave moulding and window trimmings. It must not be assumed, even in a new house, that the walls are absolutely parallel; for reasons of planning, the rooms are not always rectangular; it is, therefore, wise to measure the diagonals, as shown on the sketch plan, Fig. 3. We now come to the elevations of the four walls; the total height must be given, the depth and projection of the cornice, the height and projection of the skirting, the height and section of picture rail, the height and projection of window sill and other sizes in connection with the window which would help in designing curtains, draperies, etc.; the size of the fireplace opening, size of hearth and the material of which it is formed.

Take the out-to-out sizes first and intermediate ones afterwards, so as to form a double check by the addition of the latter. It is advisable, in the case of corner fitments, to find out if the angle is rectangular, as shown at Fig. 1. At a distance of three feet draw a line exactly parallel to the wall AB, and at a distance of three feet draw another line exactly parallel to the wall BC. These two lines will meet each other at the point D. Join AC and BD; if the diagonals are equal in length the corner is square; if not, the angle is either an obtuse or an acute one, and a template should be made, as shown in Fig. 2 in the illustration. This consists of strips of wood two or three inches wide, laid in position so as to exactly fit any irregular corner and then fixed together securely with screws and braced by means of cross-pieces to absolutely prevent displacement. The making of such a template will save time and money in the long run. One word more as to sizes. Whether the

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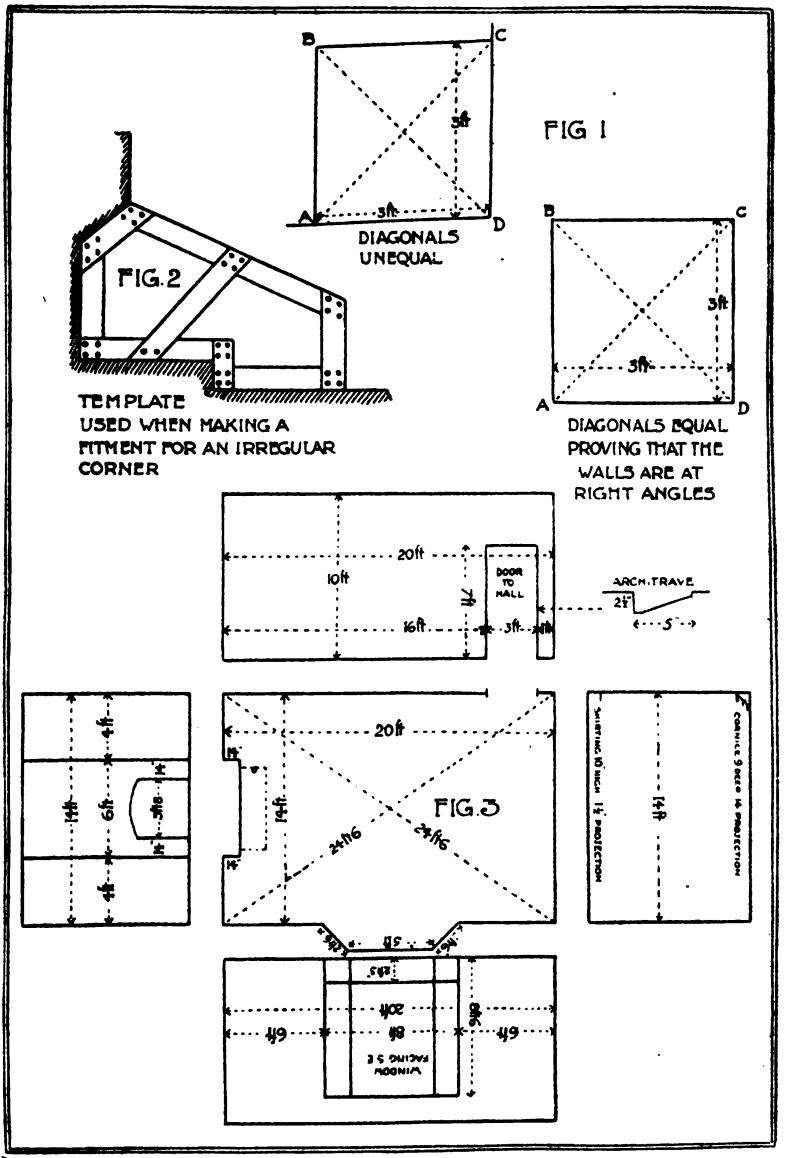

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cabinet maker is taking them for himself, or for the use of another man, he should make his arrow marks and figures in ink and sign them, giving the date on which they were taken, and the name of the house to which the plan refers.

While dealing with the question of fitments, more particularly in an upstairs room, the cabinet maker should consider the approaches to the door, whether there are any awkward angles in the staircase, or if the room itself leads out of a narrow corridor which would make it impossible to introduce a large piece of woodwork into the chamber through the doorway. The window sashes frequently have to be taken out in order to get large pieces of cabinet work or fitments into a room, trouble which would be avoided by a little foresight and precautions in construction. Another point, too, which will be helpful is to notice the condition of the brickwork, if any fires have been lighted in the house, or if the structure is still very wet. If panelling is to be fixed, note if the walls have been plugged, or if coke-breeze bricks have been built in for fixing the battens which will take the panelling. In a very large apartment the ceiling beams are often supported by vertical rolled-steel or cast-iron stanchions. These, in a panelled room, would be turned into square panelled columns; their exact sizes must be given, and their position should be carefully noted by measurements on the rough plan which is made. In an old house, note any sinking in floor or ceiling, bulging or wet walls, and traces of dry-rot. Such plans and elevations as are shown at Fig. 3, if drawn to scale, are exceedingly useful in ascertaining whether the arrangement of furniture suggested for any given room would be convenient and not appear overcrowded. The plans of tables, chairs, etc., can be jotted down to scale, and the best position for the various pieces of furniture on the walls can be shown on the elevations. This is a rapid method, which does away with the necessity of making an elaborate perspective drawing.

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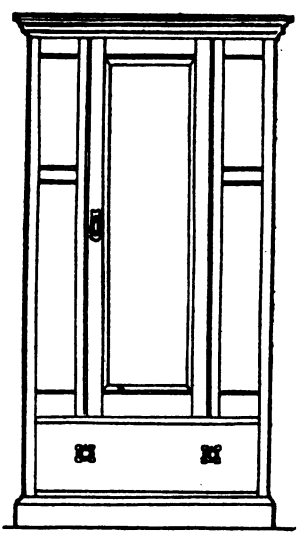
SETTING OUT OF SKIDS OR RODS

CUTTING OUT OF STOCK

Before starting the actual manufacture of any piece of furniture embodying carcase work, it is advisable to make a skid or rod, from which all sizes may be taken. This procedure is necessary even when a full-size detail drawing is available, because paper varies in size under different atmospheric conditions, having a distinct tendency to shrink and swell in dry and wet weather respectively. The making of an elaborate piece of work may extend over weeks, possibly months, and, therefore, in the case of a drawing on paper, measurements of shoulders and dimensions of other parts taken at different periods cannot be depended on, the consequence being that unlooked for discrepancies will show themselves when the work is put together. A piece of ¼ inch whitewood or deal about 11 inches wide, with the edges straight and parallel, is generally used for making a skid, and on this the measurements of the piece of furniture which is being dealt with are set out with great accuracy in pencil; sectional plans and elevations are given, stiles and rails with their accompanying mouldings are all drawn in position; in fact, every particular is shown, so that with a scale sketch and a rod, the cabinet maker should be able to make the job complete. A specimen rod of the wardrobe which we illustrate is given, a very simple piece of work being taken in order to prevent confusion; the principle of setting out a more complicated article is on precisely the same lines. A cutting list is also given; in getting out such lists of a large article, it is advisable to work systematically to avoid confusion. For example, first take off all the carcase sizes before proceeding with the drawers and doors.



Sketch of Wardrobe.

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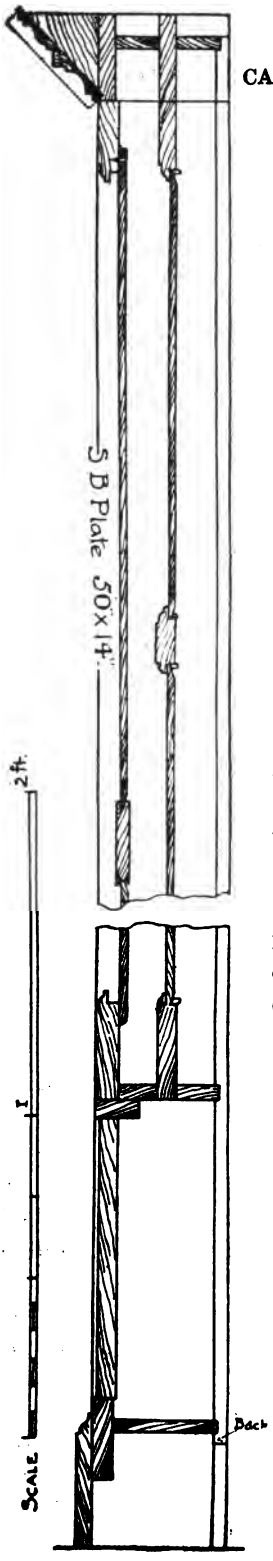
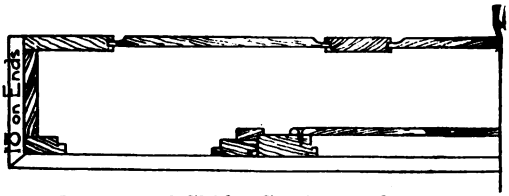


Skid showing sectional elevation.

The numbers in the first column of the specimen cutting list are put on the actual pieces of wood for the purpose of identification. It will be noticed that several items which finish at ¾ inch and ⅞ inch are both marked 1 inch. Sometimes the finished sizes are given in the end column, so that the wood may be selected accordingly, as so-called 1 inch boards vary in thickness, some



Reverse of Skid. Sectional plan.

hold to ⅞ inch full, others not more than ⅞ inch bare, thus for the ⅞ inch finish the thickest boards must be selected.

Allowances are made when taking sizes from the rod for working as follows: ½ inch on lengths, ¼ inch on widths, ⅛ inch on thicknesses, except in very wide stuff.

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CUTTING ORDER or BOARD OF SIZES
3ft Wardrobe

No	For	Length Ft	Length In	Width Ft	Width In	Thick	No of pieces	Wood	Remarks
1	Carcase Ends	6	5	1	5	¾"	2	Mahy	
2	" Top	3	0	1	5⅜	¾"	1	"	Inferior
3	" Bottom	3	0	1	5⅜	¾"	1	White wd	
4	" Shelf	3	0	1	5⅜	¾"	1	Mahy	Inferior
5	Back Stiles	6	5		3½	¾"	2	"	"
6	" Muntings	6	1¾		2½	¾"	2	"	"
7	Carcase Backs	6	1¾		9¼	¼"	3	"	"
8	Cornice Rail	2	11½		3½	1"	1	"	"
9	Drawer "	2	11½		1¾	1"	1	"	"
10	Plinth "	2	11½		3¾	1"	1	"	
11	Outside Pilasters	6	5		1¾	1"	2	"	
12	Inside "	4	11		2	1"	2	"	
13	Wing Cross Rails (Top)		8		3¼	1"	2	"	
14	" " : Centre		8		2¾	1"	2	"	
15	" " Bottom		8		4¼	1"	2	"	
16	Top Panels	1	5		6¾	½"	2	"	
17	Bottom "	2	8		6¾	½"	2	"	
18	Plinth Front	3	2		5¼	¾"	1	"	
19	" Ends	1	7¾		5¾	¾"	2	"	
20	Cornice Moulding	3	7½		4¾	1"	1	"	
21	" " Ends	1	10		4¾	1"	2	"	
22	" Backing	3	7½		3	2¾"	1	White wd	
23	" " Ends	1	10		3	2¾"	2	"	
24	Door Stiles	4	9		2½	1"	2	Mahy	
25	" Rail Top	1	4½		3¾	1"	1	"	
26	" " Bottom	1	4½		4¾	1"	1	"	
27	Glass Backs	2	1	1	4¾	¼"	2	"	Inferior
28	" Munting	1	4½		3¾	¼"	1	"	"
29	Door Stop	4	10½		1¼	⅜"	1	"	"
30	Drawer Front	2	9½		10¾	1"	1	"	
31	" Sides	1	4½		10¾	½"	2	"	Inferior
32	" Back	2	9		10	¼"	1	"	"
33	" Bottoms	1	3½	1	5	¼"	2	"	"
34	" Munting	1	4½		2½	¼"	1	"	"
35	Drawer Guides	1	3		2¾	1"	2	White wd	
36	" " (Top)	1	3		2¾	1"	2	"	
37	" Runners	1	0		1¼	¾"	2	"	

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MITREING

THE HALVING OF ANGLES

If all cabinet work was rectangular there would be very little need for a chapter on the halving of angles in mouldings and mitreing generally. This, however, is far from being the case, and it is often necessary to mitre mouldings round work which is complicated on plan, as our illustrations show. For ordinary rectangular work a mitre square and bevel are all that is necessary. Although the drawings on page 51 look complicated, when it is grasped that wherever a mitre is to be made the angle must be exactly divided, they become comparatively simple. A pair of dividers is necessary, and before going on to more complicated points we will take the two simplest examples, the halving of an acute and an obtuse angle. Fig. 1 is an obtuse angle round which it is desired to mitre a moulding. With center A describe the segment of a circle BC, cutting the lines forming the angle in B and C. With centers B and C describe further arcs, cutting each other in D. The line which joins A and D exactly halves the angle. The acute angle shown at 2 is halved in exactly the same way.

It is not only young cabinet makers, but those who have been some years in the trade who do not understand the principles of halving the angles in mitreing, and this may be proved by Fig. 3. We recently saw turned out of a small shop a shaped panel to which a moulding had been applied, as shown in Fig. 3. This, of course, was obviously wrong, as the margin should have been of the same width all round the panel. To be correct, instead of making one mitre in the top corner three should have been cut. The three angles, B, C and D must be halved; A, of course, is a right angle, and the mitre square can be used.

Fig. 6 shows the ground plan of a piece of work around which it is desired to mitre an overhanging moulding. The plan looks simple enough, but it is quite possible that if this piece of work were undertaken by a cabinet maker who did not understand drawing, he would have to do the work over twice. But if he could draw he would set out

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the plan of the work and note the angles exactly. The lines of the mitres round the right angles are, of course, drawn with the set squares, but the others can only be rightly found by exactly halving the angles. At the point C two mitres intersect. This necessitates that the moulding be built up of two parts, and the point of intersection determines the size of the part nearest the carcase. Another angle is now formed at C, and this must be again divided, and the lines of the mitre CD can be determined with precision. Thus it follows that if the mitres intersect once in work of this kind the moulding itself must be formed in two parts.

Fig. 5 shows the ground plan of a piece of work where it is necessary to apply an overhanging moulding to the interior angle, a case which very often occurs in joinery. The panelling makes an angle of 135 degrees at L and K, examples such as these often occurring in the angles of ceilings. The two angles drawn from G and H intersect at I, and the thickness of that particular part of the moulding is again determined by this point. The angle at I is halved with the line IK, the second part of the moulding being mitred to this plan.

Fig. 4 is a somewhat more complicated one, an interior angle with a pilaster breaking the corner. In this moulding the mitres intersect twice at T and O. Exactly the same principle is followed and they are halved in turn, the only difference being that in this case the moulding must consist of three parts, as is clear from the sketch given.

In the seventh and last sketch is shown a moulding which overhangs to a considerable extent a somewhat complicated plan. As soon as this ground plan is accurately drawn the angles are set out as before. In this example, the mitres intersect no less than three times at R, S and X. The moulding must, therefore, be built up in four parts, that part nearest the carcase being first mitred round and the others built upon it, the fresh angles which are formed in this way being constantly halved.

It is possible in this way to mitre a wide moulding round a piece of furniture of the most complicated plan.

The Golden Rule of Proportion

There are certain recognized principles of proportion in all work, such as the exact square, the double square,

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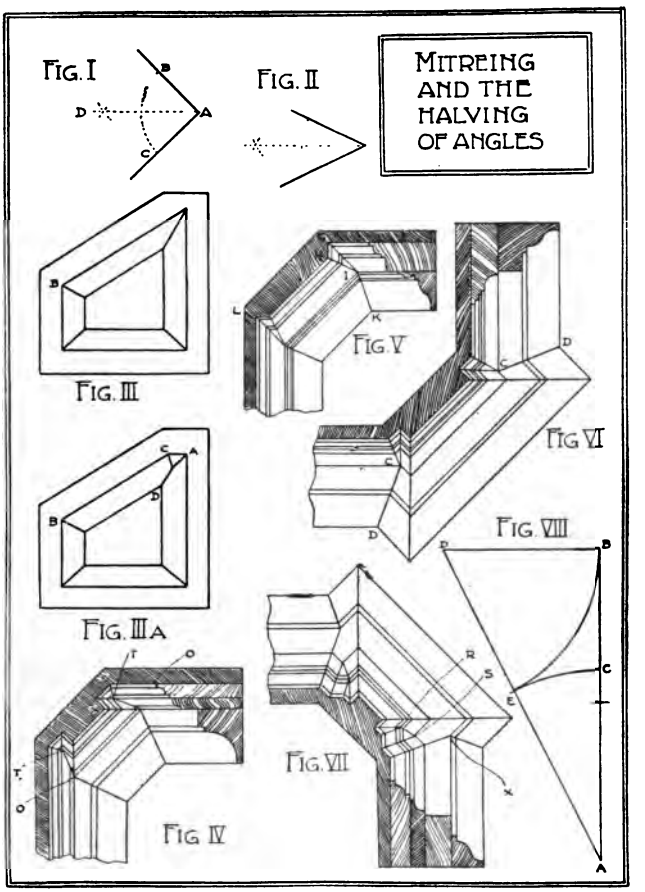

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the circle, and the equilateral triangle, and many great designers, notably Wren, the architect of St. Paul's and most of the London churches, pinned his faith to strictly geometrical figures combined in various ways. In the case of furniture certain sizes are arbitrarily fixed from the mere fact of the use to which the piece of furniture will be put. A chair must be a certain height or it will be uncomfortable, and even impossible to sit on. In the same way a writing table must stand in direct relationship to the average dimensions of the human figure. But it very often happens that though the cabinet maker has got a panel a certain height, he is not bound to size for the width, and wishes to obtain a good proportion. The following rule, which is called by the great Renaissance designers, the "Golden Rule," is helpful. Fig. 8, page 51.

For the sake of example, let AB be the height of a panel. From B set up BD, perpendicular to AB, making it half the length of AB. Join AD. With center D, and distance DB, make the segment of a circle BE. With center A and distance AE form the segment of a circle EC. Then if AC be taken as the width of the panel, a happy proportion will be obtained. This method of arriving at a good proportion is often resorted to by builders in setting out the sizes of windows.

This principle may be applied to any given dimension, the line AB always bearing a good proportion to the line AC. For instance, in setting out an oval, the length of the long axis is often determined by the design, but the width may be varied a few inches, and the point is to get a well proportioned oval. If this geometrical method of finding it be applied, if AB is the long axis, AC will be a good proportion for the shorter one.

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THE MITREING OF MOULDINGS

CURVED AND STRAIGHT

We have dealt with the halving of angles and mitreing generally, in the previous chapter; below, the mitreing of curved and straight mouldings is discussed, as work of this kind is a frequent source of misunderstanding between the turner and the cabinet maker. Instances occur when even an experienced man is liable to bungle unless he understands the principle governing the setting out of this class of work. If the cabinet maker has not cut the mitre correctly, and the members of the moulding will not exactly coincide, he is then apt to blame the turner, saying that the section has not been followed exactly. If, however, the work has been turned out mathematically correct, and the cabinet maker does not know how to set out the mitre, the joint cannot be satisfactory. Let us now consider how the mitres must be constructed when curved and straight mouldings intersect with each other.

Fig. 1, page 54, is a rectangular ground plan with circular columns on the angles, and it is required to mitre a moulding (section A) round the carcase, including the columns. On the right, a straight mitre is shown, but when this method is employed the section of the curved part of the moulding must be altered in order that the members may coincide. On the left, the profile of the curved moulding is not altered and it is, therefore, necessary to make a curved mitre. When the ground plan and the circular columns are drawn, set out the moulding A accurately; now take the distance BC, and with the dividers set off D E with center M and distance ME describe the arc EF cutting the line CF in F. Join J and F, then JF gives the line of the mitre. Parallel lines are then drawn to the mitre from the angles and one or two points on the curved surfaces on the moulding, and from the points thus obtained, and with center M draw arcs to the line ME. From the points on ME draw horizontal lines as shown, and on these mark off the distances equal to those between the dotted line OF and the profile of the moulding A. In this way, the points of

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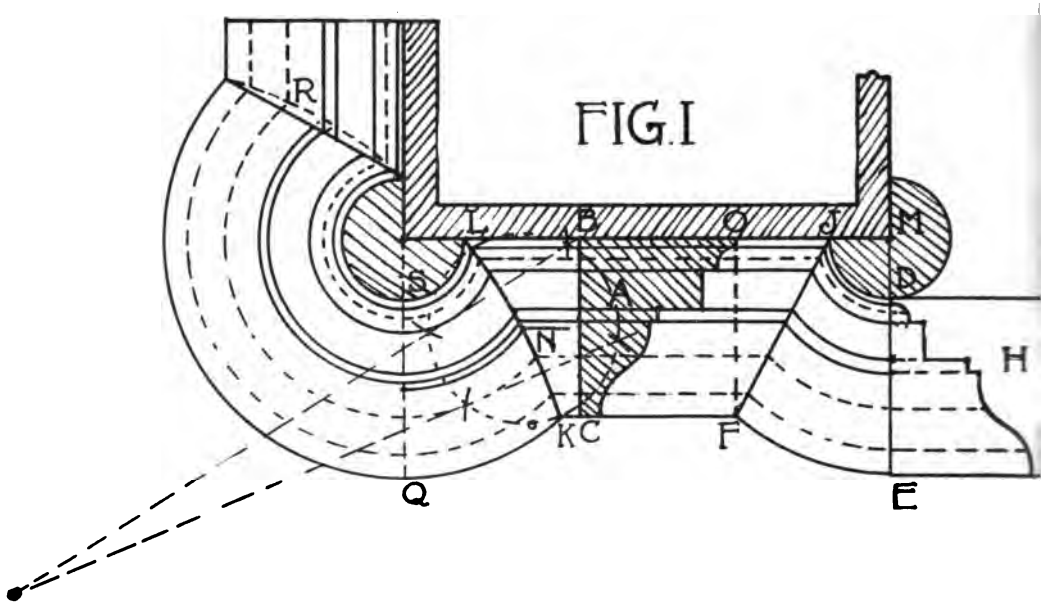
the altered profile of the moulding H are found. These can now be joined, and the true section for the turner obtained. Judged by the eye only in a drawing of so small a scale, the alteration is hardly noticeable, but if dividers are used and measurements accurately taken, it will at once be seen that there is considerable alteration of the section. How is it, then, that the members of the curved moulding do not coincide if they are exactly similar to those of the straight work? Have we not already seen in a previous article that the correct mitre is always to be found by halving the angle? The straight mitre in this case does not divide the angle. It cuts all the straight members at one angle, and



the curved at another, so that they cannot coincide with each other. This is shown clearly at R. The curved mitre LK does, however, actually divide the angle. To construct the curved mitre, mark off all the points on SQ, taking the measurements from BC, and through these points describe arcs of circles until they cut the horizontal line CF and those parallel to it. All these points of intersection are points in the curved mitre and can now be joined. The mitre must always be an arc of a circle. In order to find the center of this circle, divide both BC and SQ, and from the center of BC draw a horizontal and from the center

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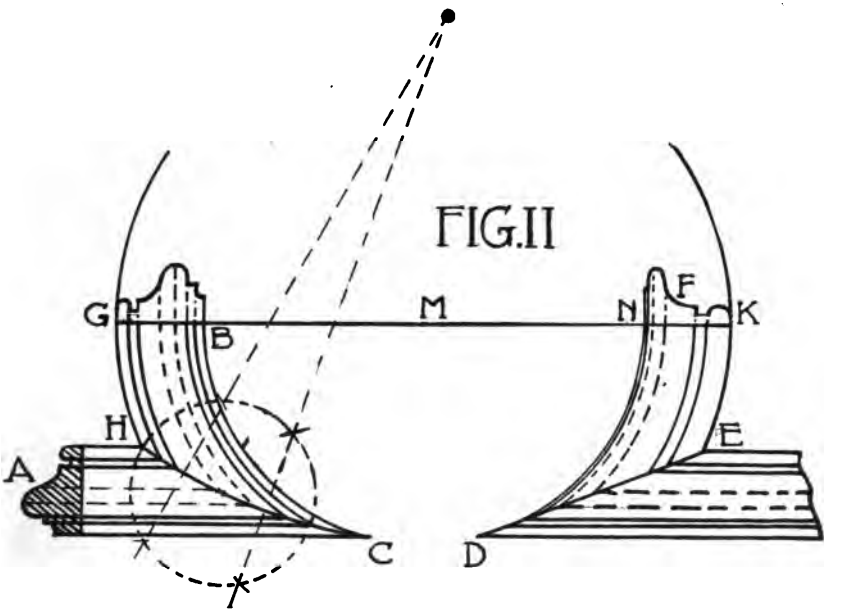
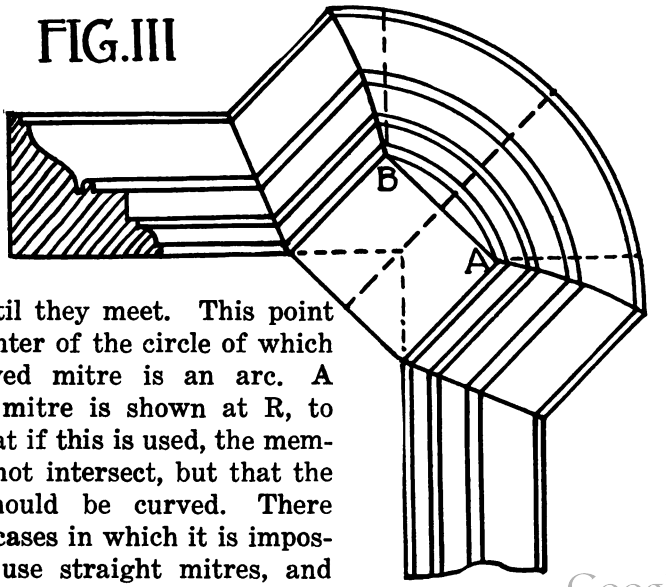
of SQ a curved line (parallel to the other members of the curved moulding). These meet in N; with center N describe a circle of convenient size; with center K and the



same radius cut the circle twice. Proceed in the same way with center L, join the points of intersection and produce



them until they meet. This point is the center of the circle of which the curved mitre is an arc. A straight mitre is shown at R, to prove that if this is used, the members do not intersect, but that the mitre should be curved. There are also cases in which it is impossible to use straight mitres, and

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then it is, of course, imperative to employ a curve. An example is given at Fig. 2. To a panel a circular moulding is applied, having the same section as that at the sides, and it is necessary to mitre the two. If a straight mitre is used

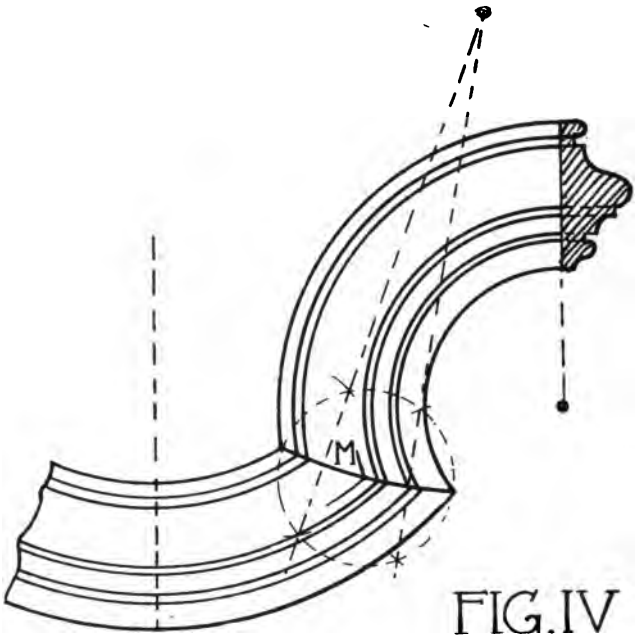

FIG. IV

and the section of the circular moulding altered, it will scarcely bear any resemblance to the section of the straight parts. See F. To find the line of the curved mitre, first set out the profile of the straight moulding at A, and draw horizontal lines from various points on its surface, and with the center M draw the arc BC. All the points which fall on the perpendicular of A should now be set off on the horizontal line drawn through M, as shown in the drawing. From all these points erect perpendiculars and mark off the heights of the profile which can then be accurately drawn through the points so obtained.

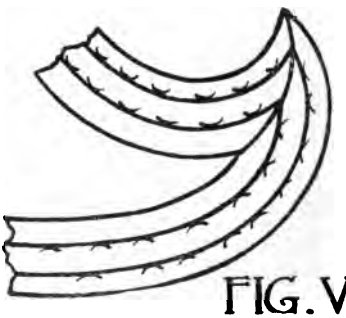

FIG. V

With center M, arcs can then be drawn from the various points in order, until they meet with the corresponding

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horizontal lines drawn from A. If a curve is drawn through the points of junction they will give the line of the curved mitre. These can either be drawn freehand or the mitre can be struck with compasses, the center point being found exactly the same way as explained in Fig. 1. On the right at F, a moulding is drawn as it would appear if a straight mitre was used. For this purpose, the horizontal lines from A have been prolonged towards the right and the outer lines of the curved moulding ND and KE drawn from the center M corresponding to BC and GH respectively. If D and E are joined this will be the line of the straight mitre. Now draw arcs of circles from the points of intersection to F, and at these points set up perpendiculars and measure off the heights as previously done at B. Join the points so obtained, in order to get the profile of the moulding and it will be seen that it is so altered as to be absolutely useless. At Fig. 3 an example is shown in the working out of which many mistakes have been made. The sketch is a plan of a piece of furniture with a canted corner applied to which is a projecting pilaster with a bow front. In order to render the construction of the job easier, the curved moulding is set back to the lines BA. The back of the curved cornice moulding does not follow the line of the pilaster front, but the pilaster itself is notched out at the top to the depth of the moulding, and the back of the curved moulding is straight as at BA in order that a straight glue joint may be used. The two right angles at

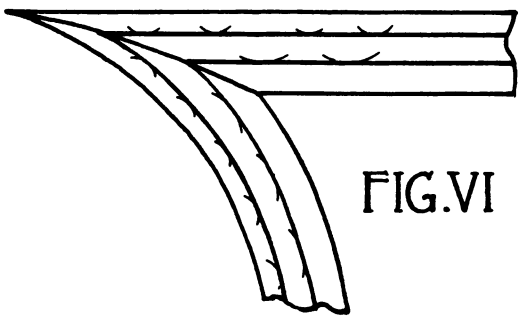

FIG.VI

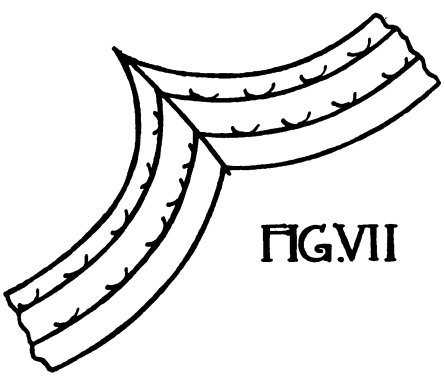

FIG.VII

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A and B lead the cabinet maker who has had no experience of a mitre of this kind astray. Seeing that the exterior angles are right angles, many a man has simply divided the angle with a straight mitre, as shown by the dotted lines, whereas, to be correct, the curve must be used as shown on the plan. At Fig. 4, two circular mouldings are mitred. The breadth of the members are set out on each part, and the line drawn through the points of junction gives the curve of the mitre. As before, this curve can also be struck by finding the center as described in Fig. 1; M is the center point of the dotted circle. At Fig. 5 irregular curved mouldings are mitred. If several lines are drawn parallel to the edges of the moulding, their points of intersection will give the curve of the mitres. At Fig. 6 a straight and irregularly curved moulding are employed together, the same process as before being used, and at Fig. 7, two mouldings of dissimilar curvature are treated in the same way.

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MOULDINGS

THEIR APPLICATION

Mouldings are decorative rather than constructional features, but the practical cabinet maker has to employ

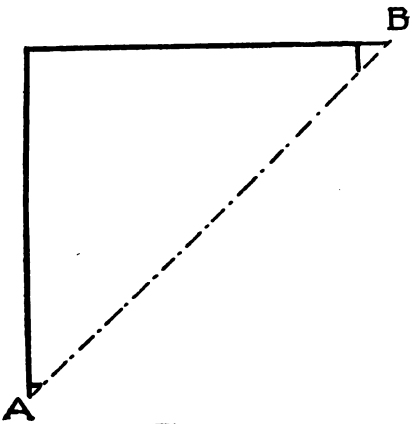

Fig. 1

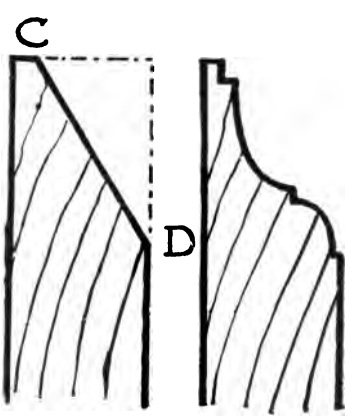

Fig. 2

them so frequently that a short chapter as to the laws which govern their use will be of service. The chief reason for

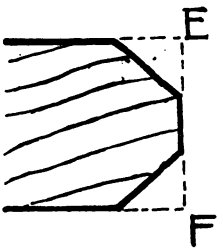

Fig. 3

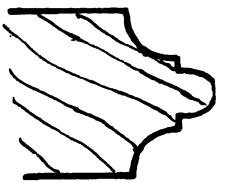

Fig. 4

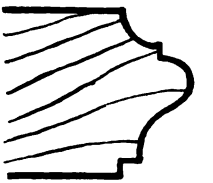

Fig. 5

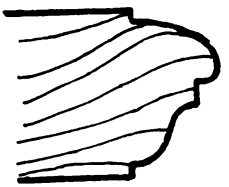

Fig. 6

the introduction of mouldings is to give a play of light and shade and to accentuate certain prominent features of furniture and cabinet work. Take a piece of panelling framed up of stiles, rails and panels without any moulding whatever, and place it by the side of a similar piece with the cornice, plinth and panel mouldings in position, and an idea is gained of how much char-

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acter is imparted to woodwork by this simple means. It is, therefore, worth while to give considerable thought to the best type of moulding to be employed in any given situation. Furniture, however simple, may be made attractive and dignified in appearance by the proper use of

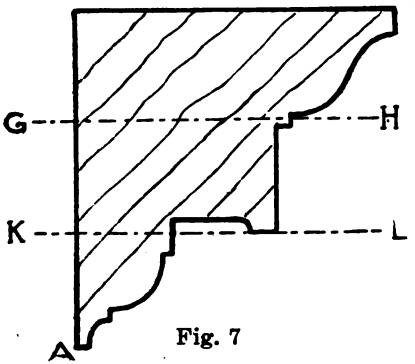

Fig. 7

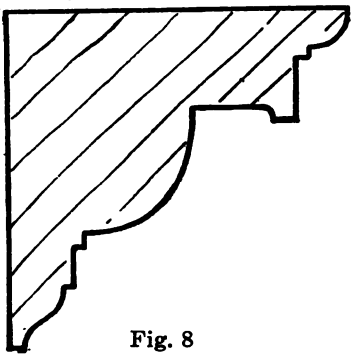

Fig. 8

moulded work of good proportion and suitable outline for the position it occupies. The profile of a moulding which will occupy a horizontal position above the eye—that is to say, anything above about 6 feet 6 inches from the floor line—should in its general outline follow a line drawn at

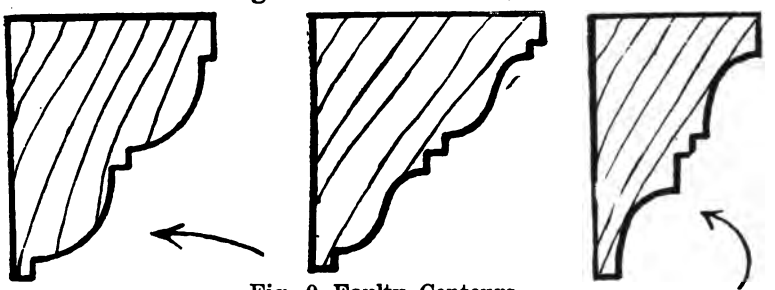

Fig. 9 Faulty Contours

45 degrees upwards and outwards from its lowest point, A (Fig. 1, page 59). This can be varied, of course, according to the taste of the designer, but it is a safe rule to follow for nearly every cornice mould which will be used on a wardrobe, bookcase, or the back of a sideboard. For practical reasons the mouldings at the base rarely project far. They are below the eye and will be seen from above, and will, therefore, in their general outline follow the direction of the line CD (Fig. 2 on the preceding page).

Faulty Contours

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Coming now to the intermediate moulding—that is to say—one which will be more or less on a level with the eye of a person either standing or sitting down—it is usual to take off both the sharp edges at E and F (Fig. 3), and the moulded detail takes such forms as those which are illustrated at 4, 5 and 6. The reason for these distinctions is obvious if one transposes the various patterns; for instance, use Fig. 5 as a cornice mould above the eye, and the ovolo at the top will be completely lost to sight, or if Fig. 6 was used below the eye-line only one-half of it would ever be

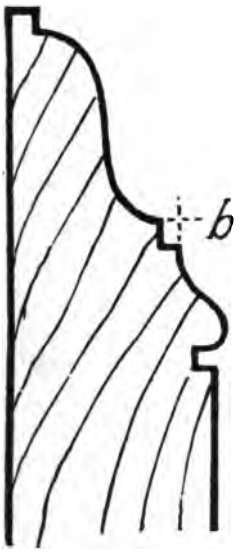

Fig. 10

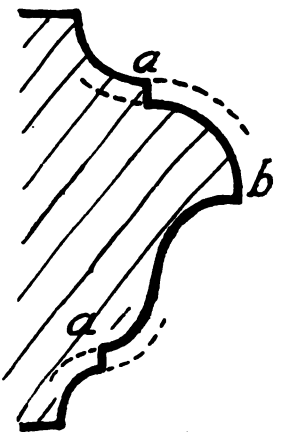

Fig. 10

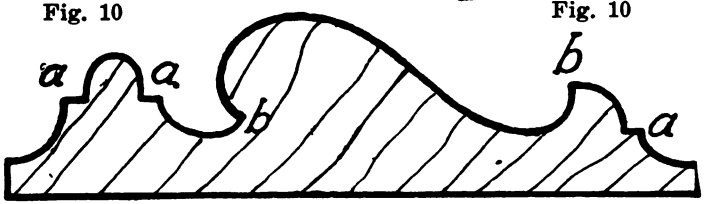

Fig. 10

a Continuous Jointing *b* Contrasted Jointing

seen. The horizontal mouldings which we have been describing throw heavy or light shadows in proportion as their projection is great or small. In the same way, if it is necessary to eccentuate a certain panel, a moulding which recesses it deeply is used. Each style has its own particular mouldings, a subject well worthy of study, but one far too lengthy to go into when dealing with the construction of

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cabinet work. But the question of the influence of material is nevertheless worth our attention. The more costly the

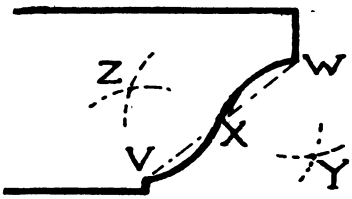


Fig. 11 A

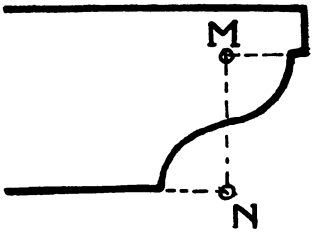


Fig. 11 B

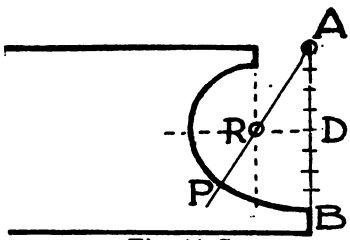
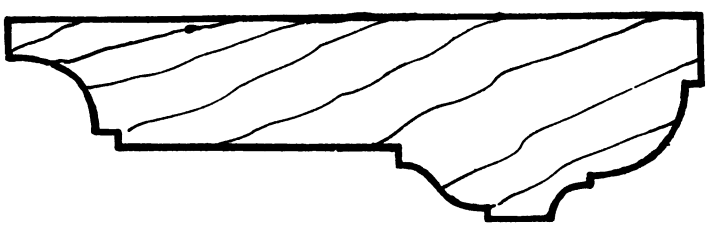


Fig. 11 C

wood the smaller the moulding may be; the individual members, should, for instance, be coarser in oak than in satinwood or mahogany. This is a principle which is common to all applied art—the more precious the material the more minute the detail with which it is ornamented. When speaking of the size of mouldings the cabinet maker will be well advised to err on the side of making them too small rather than too large, as the latter is the usual fault.

The following hints will be helpful to the cabinet maker who wishes to become proficient in the setting out of mouldings. Reverting to the cornice mould (Fig. 7), divide the



Architrave

height AB into three equal parts and draw horizontal lines GH and KL. That portion which lies between H and L should be a vertical member, as a contrast to the moulded surfaces above and below. If, on the other hand, this classic moulding is regarded as hackneyed and another type is used, any bold curve, such as that shown in the center of Fig. 8, should be in contrast to flat surfaces and fillets above and below. These principles of contrast and proportion govern the setting out of all mouldings. The architrave

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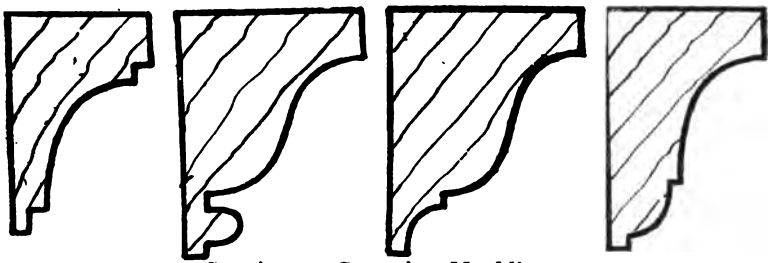
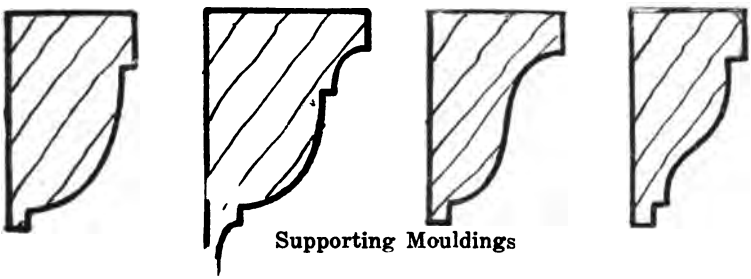
section illustrated is a good example of contrast of forms and suitability of outline for the position it occupies.



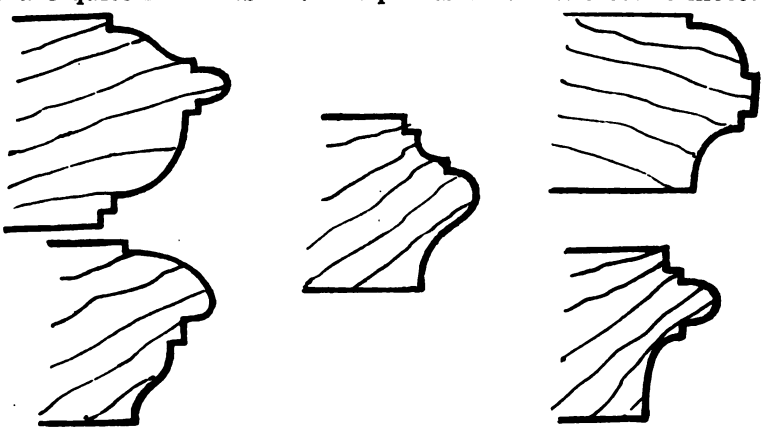
Capping or Crowning Mouldings

In a moulding which is composed of a series of members two similar contours should never be placed adjacent to each other, variety of outline and proportion being the



Supporting Mouldings

chief consideration. Such mouldings as are shown in Fig. 9 are quite inadmissible. At points where one curve meets



Intermediate Mouldings

another it is the usual custom to break it with a square, but care should be taken that the adjacent curves preserve

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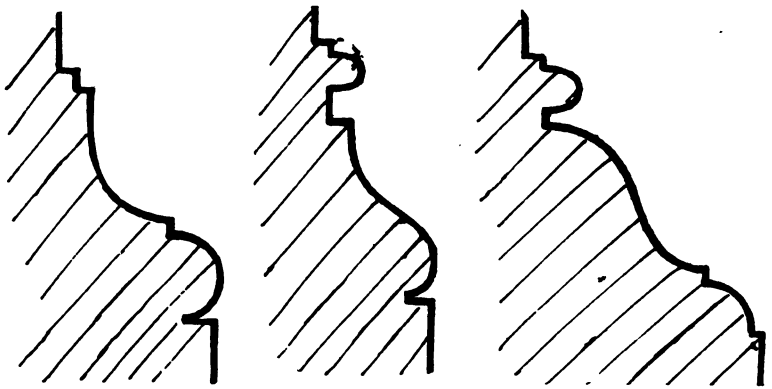
a unity of outline as indicated by the dotted lines in Fig. 10; *a a* and termed continuous jointings. In contrasted joint-



Base Mouldings

ings such as are shown at *b b*, the various curves should cut each other as far as possible at right angles, as at the points marked *b*. For the reader who is not proficient in freehand drawing the geometrical formulae for striking out the varieties of mouldings most commonly employed may be helpful (Fig. 11A). A is the Cyma-recta moulding. To construct it draw VW, and bisect it at X. With distance XW and centers X and W find the point Y. In the same way find the point Z from V and X. Y is the center for the concave part and Z the center for the convex part, which completes the moulding. The Cyma-reversa or Ogee is shown at 11B, the respective centers of the two curves are at M and N. Fig. 11C is the Scotia, the height of which must be divided into seven without the fillets. On the fourth division draw a line, RD, parallel with the fillets. Take the three upper parts in the compasses and draw a circle with center R. Make DA equal to DB, or four parts; from A draw ARP, indefinitely, cutting the former circle in P. Lastly, with center A and distance AP, describe the arc PB and the moulding will be completed.

Base Moulding

It must be remembered that a section of a moulding is only a means to an end in the actual work. When in position it is not the section but the front view which will be seen, and whether the section will make an effective front

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view depends upon the position which the moulding occupies in the general scheme and also on the amount of light and color in the material. Thus the appearance of extra thickness can be given to sideboard and table-tops. An example is illustrated showing two pieces the same thickness but with different outlines; the one with the lengthened section gives the impression of being a thicker and bolder top than the other (Fig. 12A and 12B).

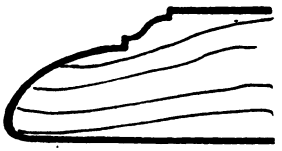

Fig. 12 A

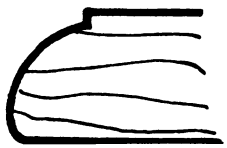

Fig. 12 B

All mouldings and series of mouldings may be roughly classed under four headings: Capping or crowning mouldings, supporting mouldings, intermediate and base mouldings, illustrations of which we give on pages 63 and 64.

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VENEERING

THE PROCESS DESCRIBED

It is now generally recognized, even by the general public, that veneering can be advantageously used as well as misapplied. In the case of certain beautiful woods it is impossible to use them in the solid, hence the need of veneering; many beautiful effects can also be obtained by the combination of different woods and grains, as centers, bandings, etc., which could not be done satisfactorily except in the form of veneers. Too much care cannot be taken in the selection of wood for veneering upon to be sure of successful work. It should be free from "wild grain," and should be clean and dry. The best wood for the purpose is Honduras mahogany, but yellow pine, whitewood and oak are often used and make satisfactory grounds. If veneer is laid on one side only, it contracts when drying and pulls the piece hollow. Damping the veneer on the back and the back of the ground with water before laying, lessens the tendency to warp, because the shrinkage takes place on both sides. It should be laid on the heart side (Fig. 1). In all cases where the conditions allow it both sides should be veneered, but this is not always satisfactory unless the veneers used are of the same strength, so that the pull of one counteracts the pull of the other. Thus, if the front is covered with saw cut veneer and the back with knife cut, the saw cut veneer is

Fig. 1 Section Showing which Side to Veneer.

too strong for the knife cut and the piece does not remain flat. To ensure wide surfaces remaining flat, both sides should be covered with knife cut veneer the grain of which runs the opposite way from the grain of the ground, *i. e.*, cross veneered, then lay another veneer (saw cut) on each side with the grain running the same way as that of the ground. By this method a constant and even pull in every

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direction is obtained. Inlaid veneer, when laid with a press, has a tendency to float when the screw or screws are tightened, and in consequence the pattern is liable to get out of place, therefore veneer pins or tacks put in each corner or suitable places are used to hold it in position. Tacks are preferable, as they can be more easily removed. When veneering with a wood caul a piece of paper should be laid between it and the veneer, and in the case of a metal caul it should be slightly greased. Wood cauls should be slightly rounded to press the glue out of the center. They are preferable to metal cauls for inlaid work in cases where the inlay is not exactly the same thickness as the veneer, the reason being that with pressure, the wood gives a little to the shape of the surface. A piece of cloth is of assistance when using metal cauls for inlaid work that is not of a uniform thickness, for the same reason. If a large surface has to be veneered with the hammer, the ground should be warmed and the outside of the veneer should be moistened with a sponge soaked with warm water or thin glue. The side to be laid covered with a coat of thin glue and quickly put on the ground, rubbed down with the hand and worked with a hammer. Commencing from one end, work from the middle to each side until neither air nor glue will come out. If after this process there are any blisters (which are really air bubbles under the veneer), the veneer must be slightly damped with warm water and a heated flat iron passed over it to melt the glue, then work again with the hammer. Wipe as dry as possible, and hand-screw stout strips of wood to prevent warping when drying. To put veneer on the end grain of wood, the glue should be well rubbed into the end grain and allowed to dry. By this means the pores are filled, and afterwards the wood will not take in more than its share of the glue.

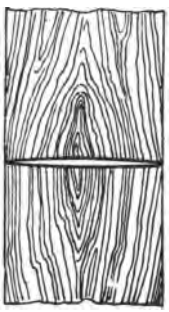

Fig. 2.

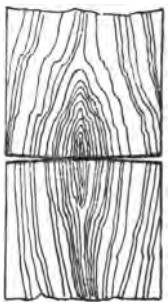

Fig. 3.

When jointing curl veneers, care should be taken to make the part where the curl occurs hollow (Fig. 2), because the curl being composed of a grain differing in nature

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and density from the grain of the plain part it will swell more when the glue is applied, consequently, if the joint is not hollow, the swelling causes the part where the curl ceases to form an open joint (Fig. 3). Certain veneers, such as pollard oak, burr walnut and burr veneers generally are inclined to buckle, therefore, before attempting to lay they should be slightly damped and pressed between hot cauls so that when cold, they will be well flattened and shrunk. Other woods, such as rosewood, which contain resin, are improved for veneering purposes by being heated to bring out some of the resin. All groundwork of soft woods such as pine should have the grain filled with thin glue size or they are liable to take more than their share of the glue, but where mahogany is used to veneer on this is not so necessary. To veneer a circular column lay the veneer around, letting it overlap, cut the joint through both edges with a chisel or veneer knife, and straight edge, then bind tightly round with ordinary chair webbing, which should be slightly damped and allowed to dry; it will then draw tight, answering to some extent as a caul. When

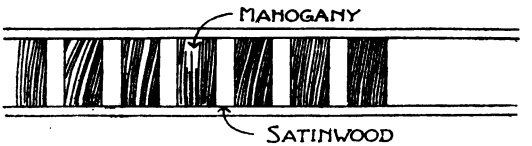

Fig. 4

veneer has to be adapted to a sharp curve it is advisable to back it with a piece of calico or canvas to prevent splitting. Oval rims and similar shapes are made with three or more pieces of veneer glued together, the center one cross grained to the others. Steam slightly for sharp curves, not too much or the glue will give. Treated in this way veneers will bend to almost any shape and when dry will remain fixed and strong. Sometimes circular rims for tables, etc., are made with six or more thick veneers glued together and bent on a caul. This, of course, is only practicable where there are a large number to be made. The inside veneer is of inferior wood and the outside the same as the other parts of the article. Tortoiseshell must be moistened in warm vinegar or acetic acid before being laid, as this treatment softens it and removes the buckles. The under side of the shell is sometimes colored with some bright color as red, etc., mixed with varnish. When the color is

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dry the shell is laid with the colored side underneath. Sometimes gold leaf is put between the ground and shell. These methods enhance the beauty of the shell, the gold leaf producing a brilliant effect through the transparency of the material. White glue should be used. If the shell is again moistened with warm vinegar or acetic acid, when laid, it makes it easier to clean the surface. Another method of getting red tortoiseshell is to mix thin boiling glue with as much bright vermilion as will make a brilliant red. Temporarily fix the shell to boards with paper between to prevent it adhering and apply the mixture until the required color is obtained, allowing each coat to dry before applying another; it is advisable to first treat a small loose piece of shell in this manner, so as to be able to control the exact shade required. To remove the buckles from the shell, glue on brown paper and press with warm wood cauls with a piece of loose paper between the shell and cauls. The brown paper remains until the shell is laid. White celluloid or ivory must not be toothed as the marks show when laid. Previous to glueing, the celluloid should be covered with a paste made from celluloid dissolved in ether, otherwise it will not adhere satisfactorily.

White glue can be made by adding a little flake white to ordinary glue. To hold metal and wood together, add a tablespoonful of Venice turpentine to each pint of glue, keeping it well stirred while boiling. To finish Boule work, take a moderately well-worn file and reduce the metal to level of shell, then rub well with rotten stone and linseed oil until level; smooth and clean off before polishing with transparent shellac, finishing off with clean spirit. Fancy stringing or banding such as this (Fig. 4) is cut from a series of strips of wood glued together. The mahogany and satinwood are first cut the required thickness and planed then cut across the grain to width and glued together, then levelled afterwards. A veneer forms the outside string. When laying a banding around a curve the process is simplified by loosening the outside string as it is worked in to enable the band to bend more easily. To inlay lines into the circular shaft of a leg lengthways it is necessary to use a box (Fig. 5); the leg can be revolved and the gauge for the string worked against the side of box. To put a horizontal banding around a leg, a groove

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should be turned to take it and the banding backed with a piece of canvas to hold it together. When bending, after

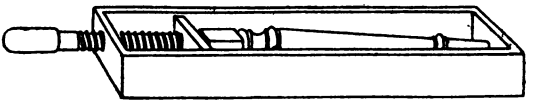

Fig. 5

placing it in position, bind tightly with a piece of string, then damp the string, and when it dries it will shrink and press the banding into the groove.

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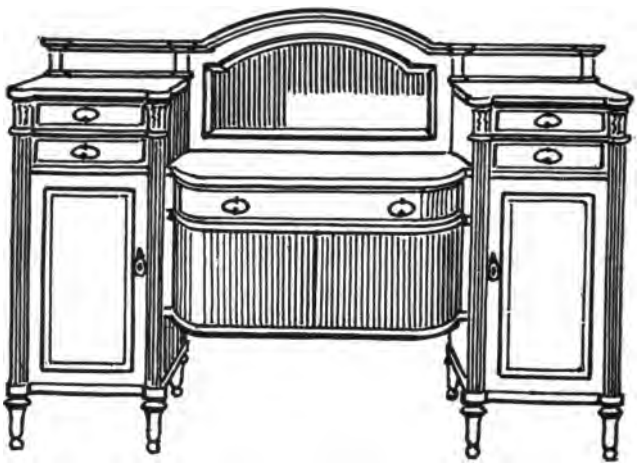

A Sideboard
(See following chapter.)

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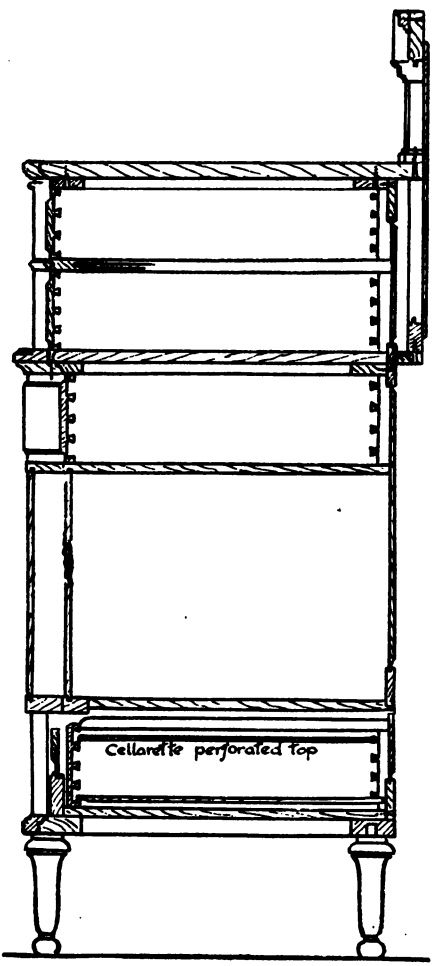
CONSTRUCTION OF A SIDEBOARD

SHOWN ON OPPOSITE PAGE

The sideboard illustrated herewith contains some unusual and interesting construction which calls for explanation. Firstly, it will be noted that the pedestals are constructed as separate complete carcases, and the three outside columns of each pedestal are rebated and applied after the carcase work has been put together. The inside back legs are fixed by means of turned pins. Vertical pieces or pilasters forming squares are used on either side of the center drawer and cupboard in order that the drawer, etc., when pulled out, shall clear the projecting columns; the door and drawer rails are made to overlap these pieces, this obviates the difficulty of getting the break around the edge of the drawer. If this plan is not adopted, a square must be put on the ends of the drawer front to get the break. The center cupboard below the drawer is enclosed with "tambour" fronts or "shutters," which are composed of beads made to slide in grooves 3/16 inch wide; the beads themselves being thicker than this, are shouldered



End Sectional Elevation

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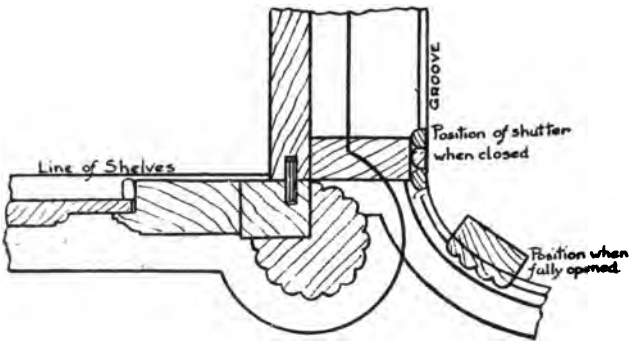
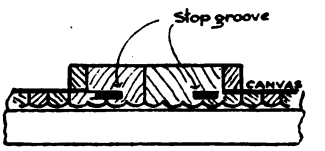
both top and bottom. Great care should be exercised in the working of the grooves at the shaped ends to insure the shutter acting freely. The best method to adopt in making up the shutter is to get a strong piece of canvas, stretch it on

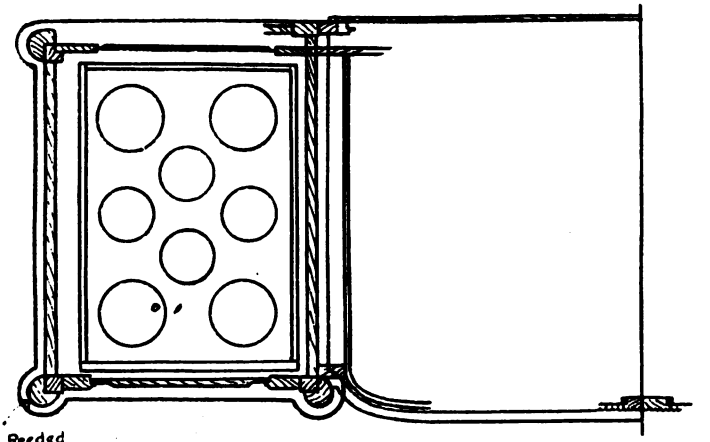


SECTION AT A

a board and glue the beads separately to it. Care, however, must be taken that the individual beads are not glued together, they should remain flexible, so that they are able to adjust themselves easily to the shaped grooves when the shutter is opened or closed. If the edge of each bead is rubbed over with candle wax, it will prevent the glue, which has a habit of working up, from adhering. To further assist the running round the corner, small revolving wheels



SECTION AT B



Plan Showing Cellarette Drawer, etc.

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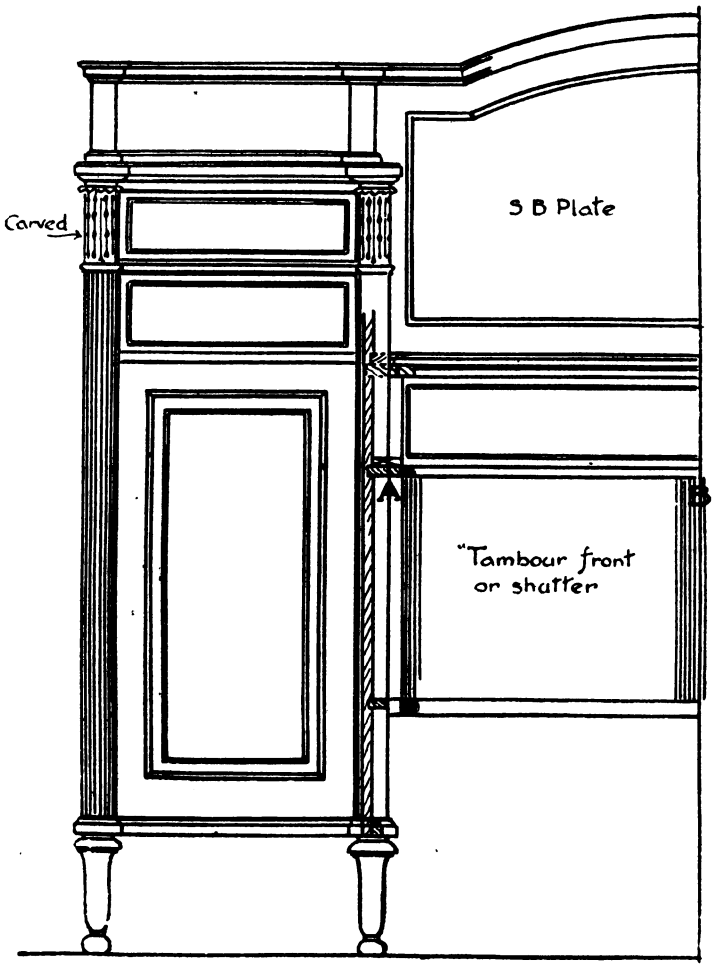
should be screwed to the top and bottom of the cupboard against the "shutter."

As shown in section at B, larger pieces are used in the center to take the lock and bolts and to these pieces the canvas is attached and covered in with squares to hide the somewhat unsightly edges.



Front Elevation

The construction of the cellarette drawer is shown on the plan and elevational drawings. Such drawers are often lined with lead with wire divisions, but the one in this sideboard is constructed entirely of wood. The perforated piece at the top rests on a bead fixed to the drawer sides, etc.,

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and is held in position by another bead above. A point worth noting in constructing a cellarette drawer with a drawer above it is to give sufficient height for tall bottles, such as hock bottles. This measurement should in no case be less than 15 inches from bottom of cellarette.

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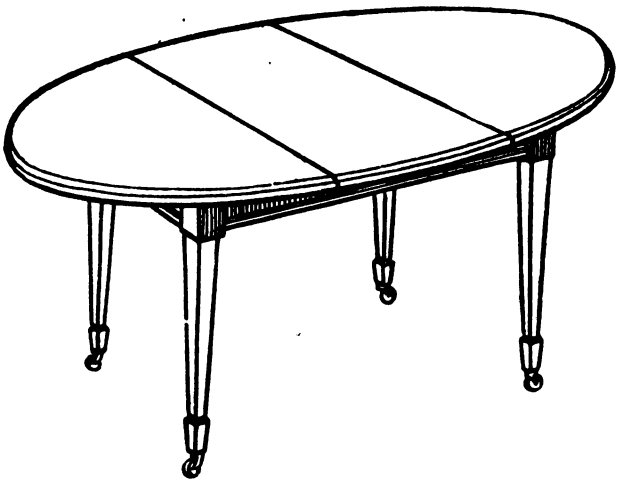

An Oval Telescope Table

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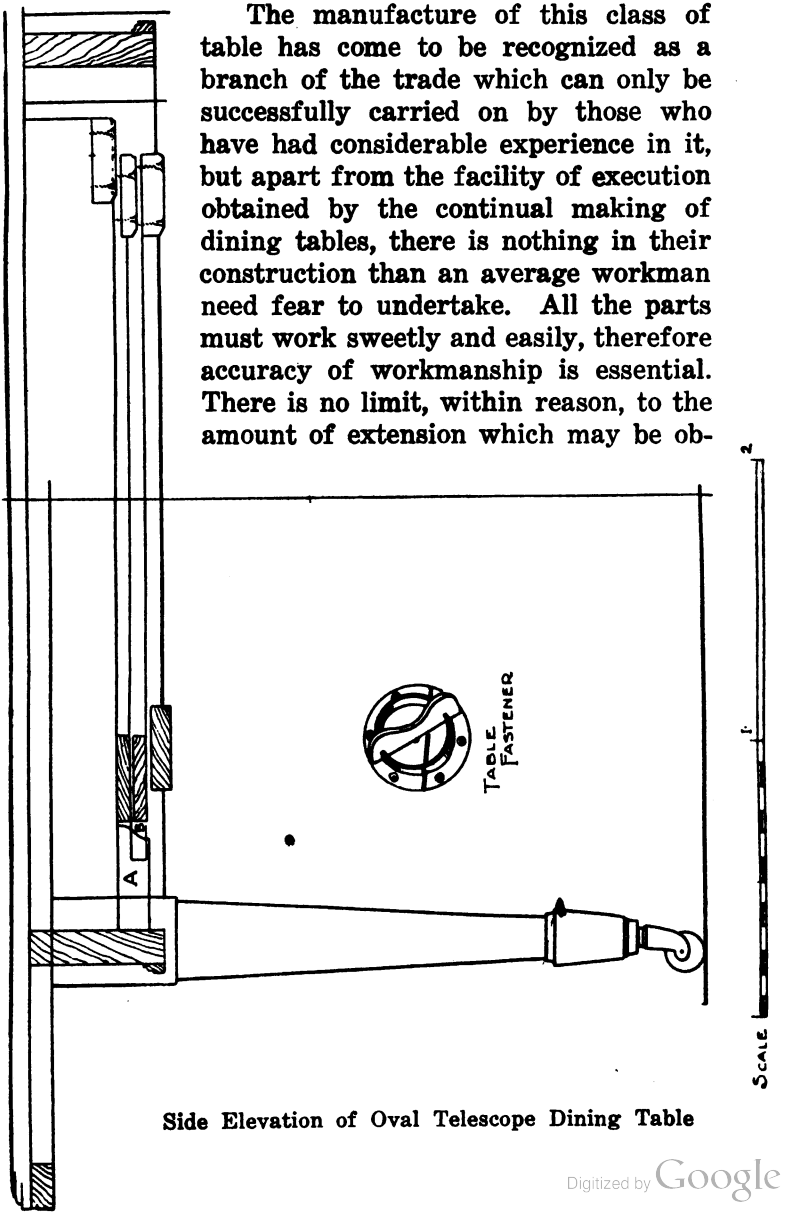
CONSTRUCTION OF A TABLE

OF THE OVAL TELESCOPE TYPE

The manufacture of this class of table has come to be recognized as a branch of the trade which can only be successfully carried on by those who have had considerable experience in it, but apart from the facility of execution obtained by the continual making of dining tables, there is nothing in their construction than an average workman need fear to undertake. All the parts must work sweetly and easily, therefore accuracy of workmanship is essential. There is no limit, within reason, to the amount of extension which may be ob-



Side Elevation of Oval Telescope Dining Table

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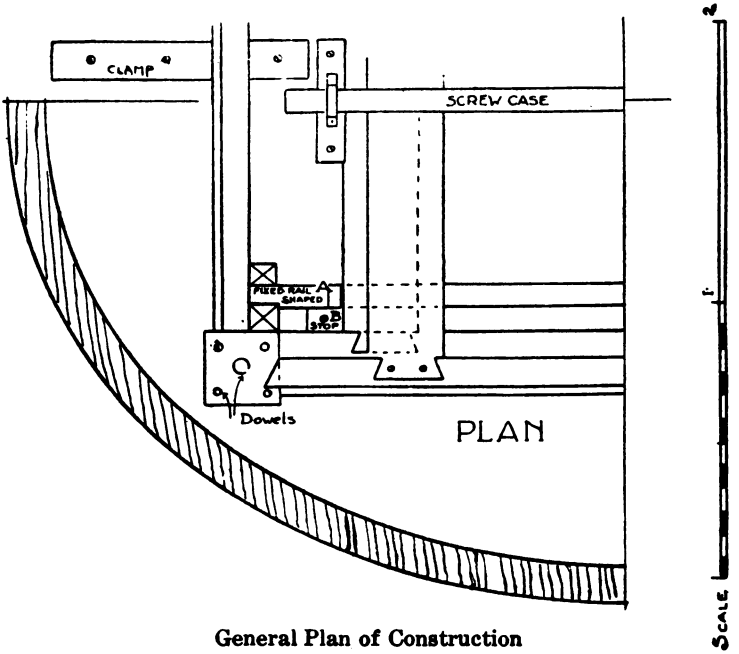
tained in a table of this kind. This is effected by increasing the number of slides and making them correspondingly stouter when the extension is unusually large. To insure that the slides shall run smoothly, select straight, even-grained wood, and see that the parts fit together without binding, at the same time using care to get an exact fit to avoid looseness or play of the various parts. The slides and "lopers" or fixed rails should be slightly rounded on the top edge lengthways, and the grooves made parallel. This gives a slight curve to the table top when fully drawn out; a little



General Plan of Construction

rise is sufficient (about ¼ inch in 4 feet) to counteract what otherwise would be a natural drop or sagging of the center. The outside rails are tenoned one end only, and for the sake of a neat appearance, the opposite ends of the rails are beveled and housed into the legs.

This also gives additional support to the frame when closed. The sizes of the leaves vary from 16 inches to 20 inches, and they are held in position by dowels, the holes for which must be regularly placed so that the leaves are interchangeable. Although it is the usual practice to number and mark each leaf for certain positions, the under sides of the leaves should be planed and cleaned and the

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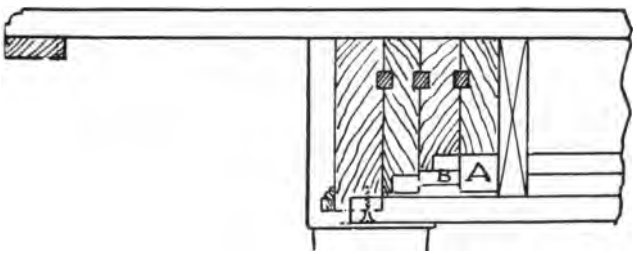
position of the dowels gauged from that side and from one end, using a template. Rosewood or any other very hard wood should be used for the dowels, with the ends nicely rounded, so that they easily find their corresponding holes. When finished, all the leaves are inserted and tightened up, and the whole is cleaned off together. For convenience of packing, the legs are sometimes shouldered, as shown, and made so that they can be removed with ease, being held in position when in use by one large or four smaller dowels or pins. For tables over 10 feet long, a center leg becomes almost a necessity. Stout pieces strengthening the shaped end pieces should be used, as there is a weakness of the



End Section

grain in this type of table. It should be noted that the lining is of cross-grained wood, following the grain of the top, and should, if possible, be cut from the same piece of wood, the reason for this being that the condition of both would be more likely to be the same, and there would be, consequently, less liability of the two parts swelling or shrinking away from each other. Too much importance can hardly be attached to the value of using reliable stuff for dining tables in the top, rails and, in fact, all parts. They are sometimes made without the screw, and the leaves are then held by a table fastener, as shown in our illustration. It is made of brass, and screwed to the under side, the action of the clip being to pull the joints together.

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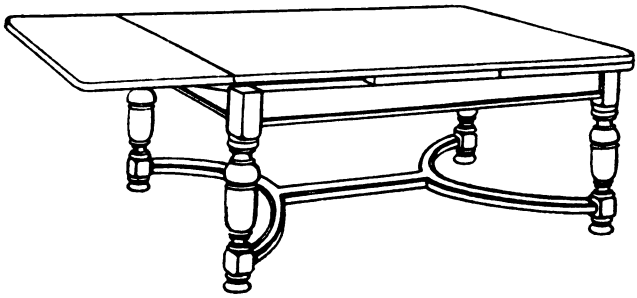

Perspective Sketch of Draw Table

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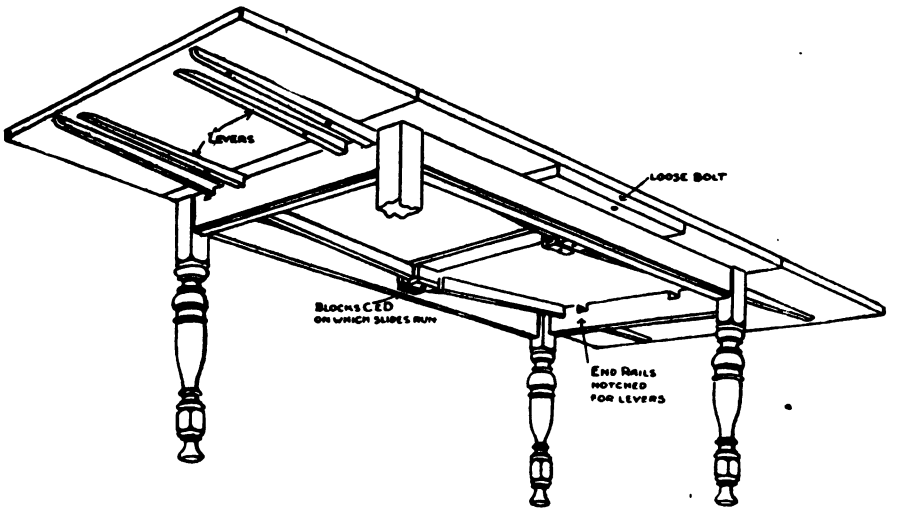
CONSTRUCTION OF A TABLE

OF THE DRAW OR EXTENSION TYPE

In spite of modern improvements in table making, it is an open question whether the old draw table is not still one of the most satisfactory ways of constructing an extending table. When a room is furnished in the Jacobean or Elizabethan manner, it is essential, in keeping to the correct style, that the table should be constructed in this way, but, as the cabinet maker is not often called upon to do it, he may find the accompanying plans and sketches of service. The top of such a table is not screwed down but held in position with four dowels fixed in the cross rail and which



Underside of Table Showing Construction.

are let into the top loose and dry. It is not possible, however, for the top to be lifted right off, the loose bolts fixed at the sides preventing this, while allowing it to rise sufficiently for the extending leaves to pass into position underneath it.

To effect this in a table of small size it is only necessary to lean over and raise the main top slightly with the hands when the extending leaves may be pushed into position.

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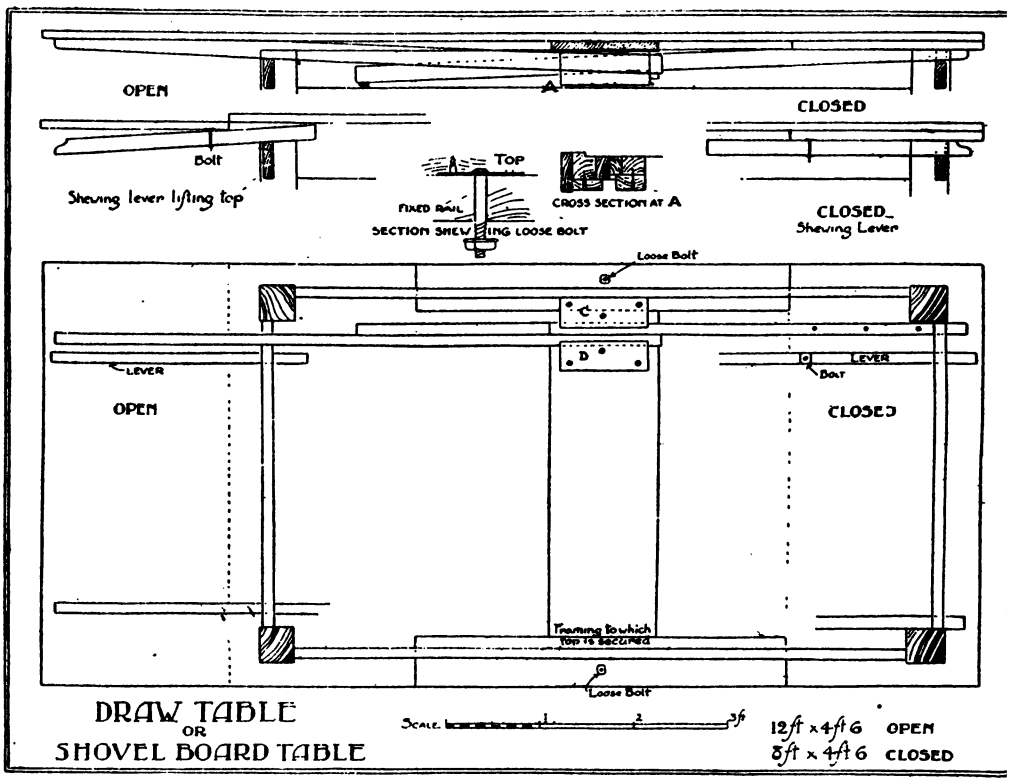
This would be inconvenient, and in many cases impossible, in the case of a large table. In this case levers, as shown on the drawing, are provided, a slight downward pressure on which serves to raise the main top sufficiently for the extending leaf to slide into its place. Both the main top and the levers are loosely bolted to allow the requisite play.

Some care is needed in setting out the angles for the long rails which support the extending pieces in order that



when the table is open to its full extent the three parts may lie true in one horizontal surface. It is also very necessary to obviate any tendency to warp, both in the main top and the leaves, and for this reason well-seasoned wood must be selected and these parts should all be framed. (See sketch opposite.) The plan and elevation, sketched above, show the positions of the long supporting rails when the extending leaves are both open and closed. The ends nearest

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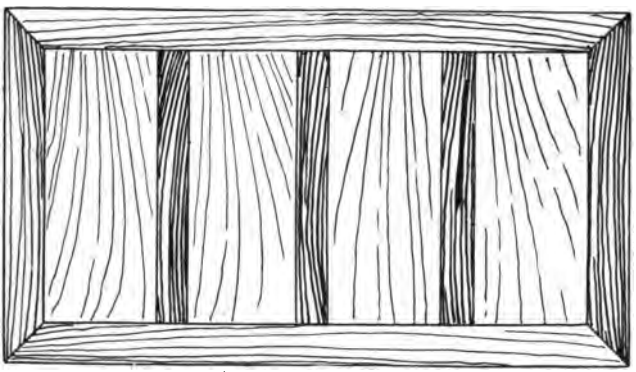
the center are fitted with stops to prevent the rails being pulled out too far.

The construction of this table is from start to finish cabinet maker's work if we except the loose bolts. By this we mean that there is no engineering or other mechanism, hinges and the long threaded screw being all done away with. By the use of such a table there is no wear and tear on the carpets, as the legs are always stationary, and another advantage is that the legs are placed in convenient positions where they are not likely to interfere with the comfort of the diners. We must warn readers against being



Main Top, Framed to Prevent Warping. (See section below.)

confused by the lines of the levers in the drawings. These are not really essential constructional parts, although very useful additions. This note is simply made to prevent any possibility of confusion in reading the working drawing. The long canted rails run in juxtaposition to each other having a bearing on the end rails of the framing which are notched to receive them, and on the supports marked C and D. See the plan showing the underside of top.

A section through framing of top.

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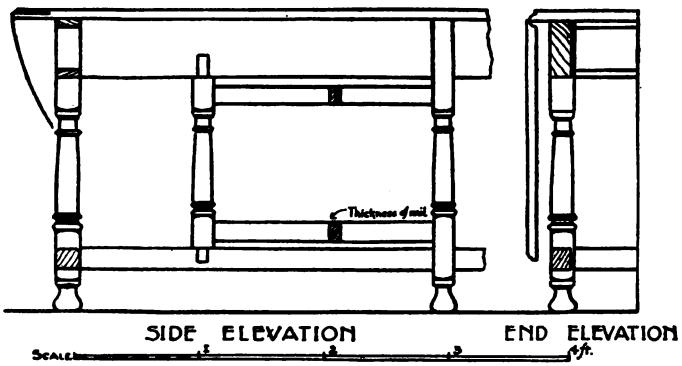
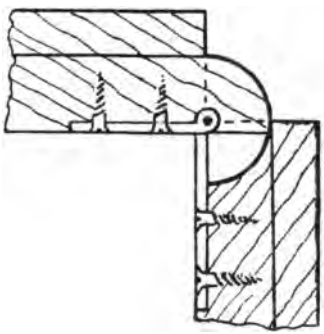


Side and End View of an Oval Gate Leg Table.



Section Showing The Joint Complete.

Section Showing Setting of Rule Joint.

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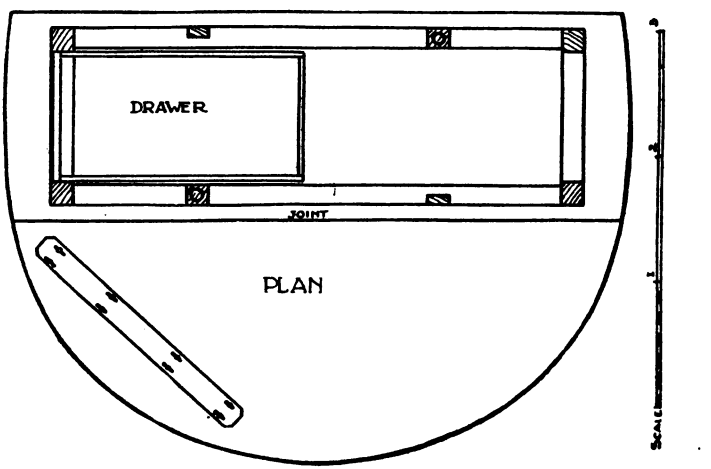
CONSTRUCTION OF A TABLE

OF THE OVAL GATE LEG TYPE

This useful type of table does not need much description. The leaves, being of fairly wide stuff, stout pieces about 1 inch thick are screwed across each side to keep them from warping; they should be slot screwed as shown below.

In flap tables of the better kind, instead of the edges being square where they are hinged, the rule joint is used. The former, though equally strong, is not nearly as good in appearance. The rule joint often presents a difficulty to the inexperienced hand. Upon the accuracy of its setting



Plan of Oval Gate Leg Table.

out depends the easy working of the joint. The chief thing to remember in all hinge joints is that the center or knuckle of the hinge is the center upon which the joint pivots. Thus the center of the hinge or the knuckle must be the center from which the circle of the joint is struck. The position of the square above the oval and on the leaf must be parallel to the center of the knuckle (see the dotted lines, illustrated page 86.) Back-flap hinges are used for hinging the leaves, the knuckles being let into the top.

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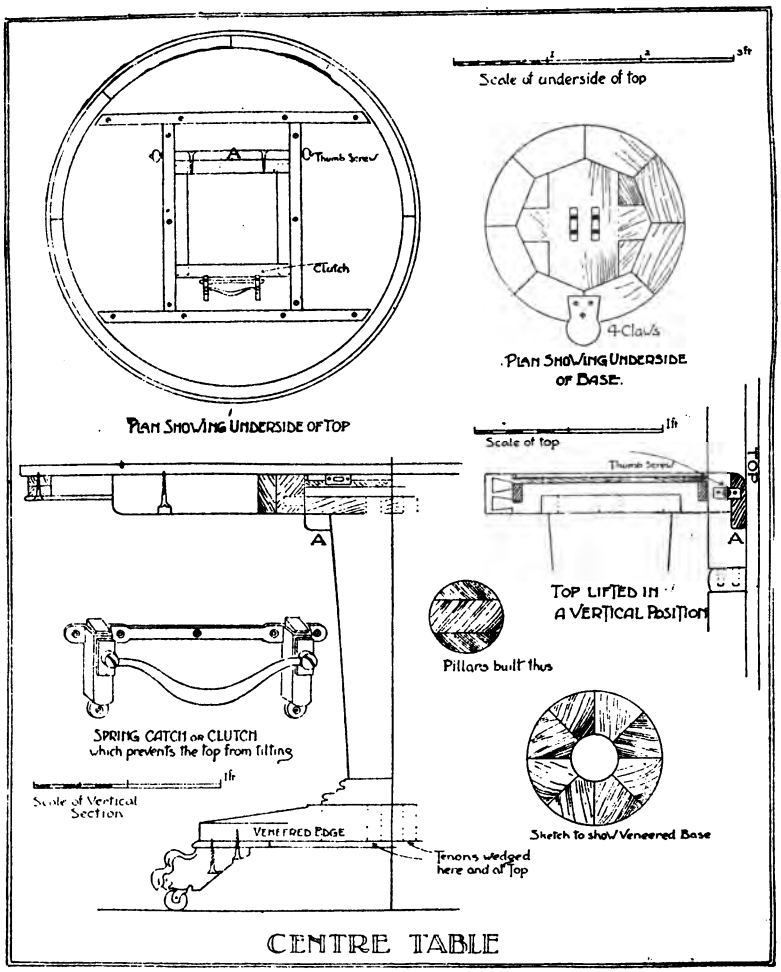

Plans and Details of a Centre Table.

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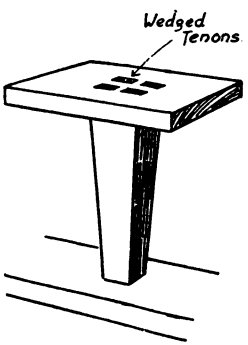
CONSTRUCTION OF A TABLE

OF THE CENTRE TABLE TYPE

We make no apology for illustrating the center table, page 88, as this series of articles does not deal with design, but solely with construction and technical difficulties met with in workshop practice. This type of table gives an insight into the building up of any circular work, and makers will see, on carefully examining the accompanying plans and elevations, that it is full of unusual and sound construction not met with every day even in the best shops. The construction which is shown is such as would be necessary if it were to be made of some finely-figured or costly wood. It is an example in which veneering is perfectly legitimate, in fact, this process adds to the durability of the table. We would draw our readers' attention to the fundamental principle of construction sketched below, the circular parts being built round this. Greater strength is obtained by the use of wedged tenons at the top and bottom (see plan showing underside of base.) At the base of the main support are three cross rails, one long and two short, the angles being filled in such a manner that the grain is all converging in one direction.

The sketch at the bottom right-hand corner of the illustration on page 88 shows the method of veneering the base. The cross section given shows the best way of building it up



Fundamental Principle of Construction.

Cross section through base

and readers should notice how cleverly difficulties of various grains in the wood are obviated, a very good point when it is taken into consideration that the base will have to be veneered. This base now forms a very rigid platform into which the claw feet may be firmly screwed. The center

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pillar is built up as shown, and should be veneered with four separate pieces applied vertically, each rubbed down with the hammer and allowed to dry before putting down another. Every joint should be covered with a strip of linen or canvas to hold it together while drying. The reader should note the construction of the under framing of the top, which is so arranged that it may be placed in a vertical position, the construction being clearly seen on the plan and elevational drawings. The top is fixed by aid of thumb-screws, which also act as pivots. To prevent the possibility of its tilting at an inopportune moment, a strong catch or clutch (an enlarged sketch of which is given), is fitted, which automatically locks the top in position when it is lowered into place horizontally. There are many "tips" for the construction of built-up circular work which may be gathered from a careful study of construction of this centre table.

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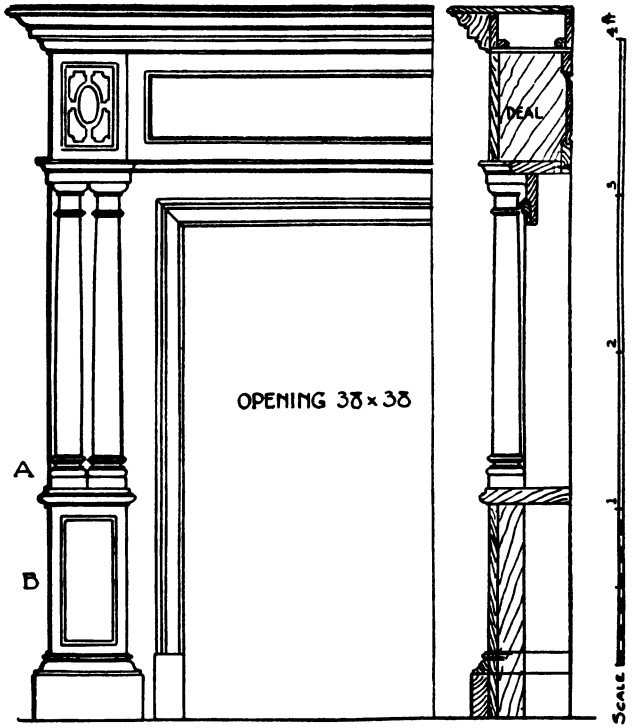

Front and End View of Mantelpiece.

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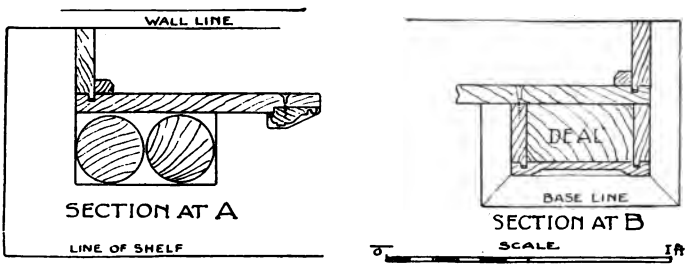
CONSTRUCTION OF A MANTELPIECE

SHOWN ON OPPOSITE PAGE

The making of mantelpieces is not generally the work of a cabinet maker, but the varying conditions of trade demand that every man should have an all-round knowledge; therefore a few notes on the principles governing successful mantel construction will not be out of place. It is essential that the various parts should be built up wherever possible, because the heat from the fire to which the



woodwork is necessarily exposed would tend to develop shakes in large solid blocks. No joint should depend entirely on glue, if it is possible to aid it with screws, and all the interior angles should be angle blocked. The moulding surrounding the opening is rebated over the edges of the framing, so that any shrinkage will not be apparent. When treated like this, it is called a bolection moulding. (See drawing above.)

The back should have a coat or two of paint before fixing. It is almost unnecessary to add that it should not be fixed until the walls of the building are quite dry.

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Fret Side Panels in Hood of the Clock Shown on Following Pages.

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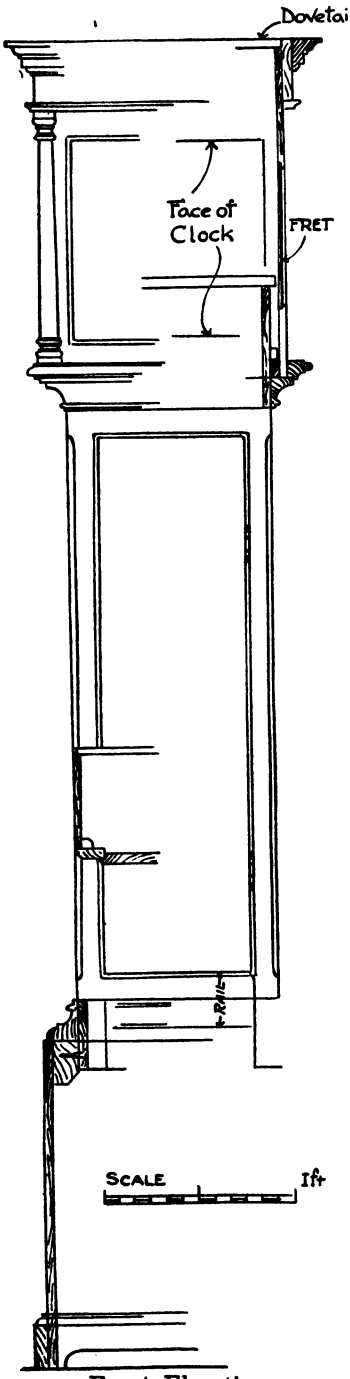

Front Elevation.

A CLOCK CASE

OF THE GRANDFATHER TYPE

In considering grandfather clock cases, as far as the mechanism is concerned, we have only to deal with those timepieces driven by the falling of a weight and controlled either by a vertical verge or a pendulum. Very much increased accuracy was obtained in the clock-maker's craft by the addition of the long pendulum, and it is highly probable that the long case was evolved to protect it from disturbance.

Although at the present day we have clocks electrically driven which need neither weights nor pendulum, and, indeed, in some cases no works at all, there is still a demand for the old-fashioned variety of time-keeper; hence our reason for a chapter on the proper construction of a case.

The elevational and sectional drawings show the most important constructional points to be borne in mind, but there are one or two minor matters to which attention should be called. It is highly essential that dust should be excluded as far as possible from the case, and

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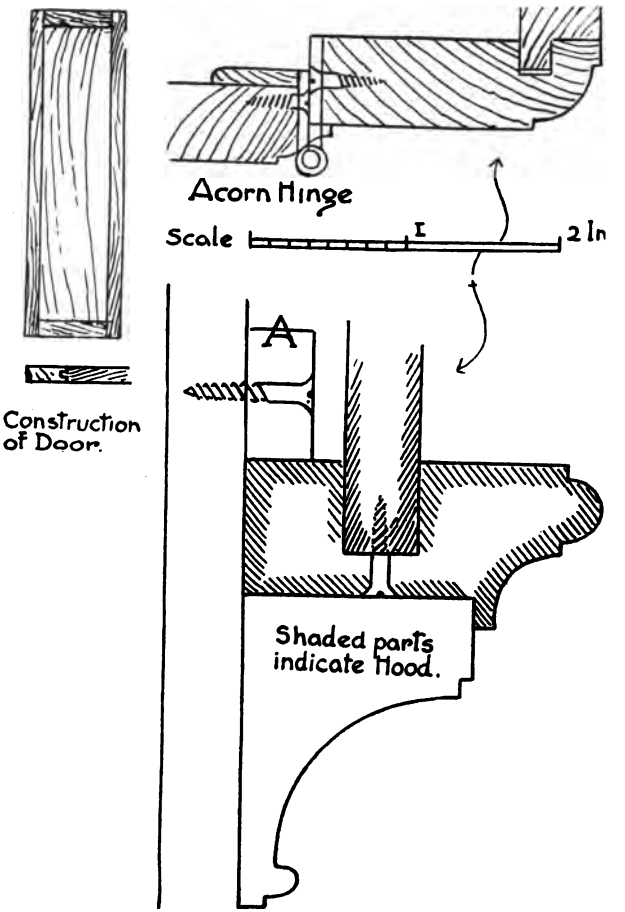
the cabinet making should thus be of a high order. The door enclosing the pendulum should be framed together as shown, both the front and back being veneered. This will prevent warping and open joints. It should be hung on acorn hinges, having one flange wider than the other, as shown in the drawing below. By this means a good "hold" is obtained for the screws. The eye of the hinge pro-



Section Showing Detachment of Hood.

jects from the framing and is lineable with the front edge of the door in order to give the moulded part proper clearance when the door is opened. The hood, which contains the mechanism of the clock itself, is made to slide forward, and, if necessary, can be taken off entirely. It is, however, locked into position and so kept from tilting by the fillet A,

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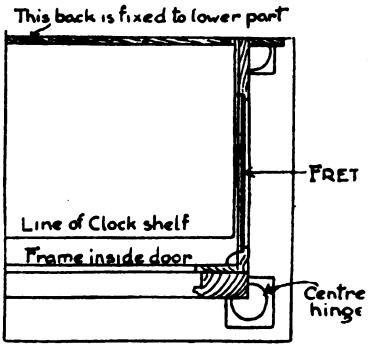
screwed to the carcase end, a groove being thus formed between this and the cavetto moulding below, into which the lower part of the hood slides. In order that the chimes may be heard more distinctly, the side panels of the hood are usually formed of a fret-cut panel, made either of three-ply veneer, backed with silk, or of brass, treated in a simi-



Plan of Hood.

lar way. The silk serves to keep the case as dust proof as possible. If the clock has chimes attached to it, it is essential to allow sufficient space in the top of the hood to accommodate them.

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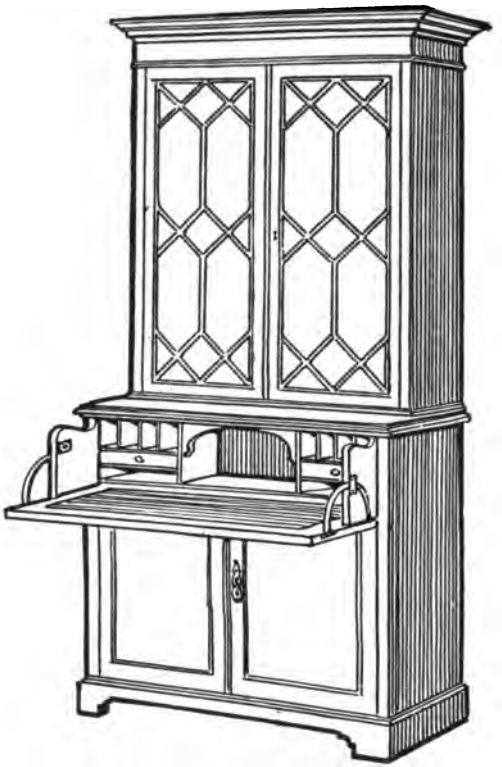

Perspective Sketch of a Secretaire Book Case.

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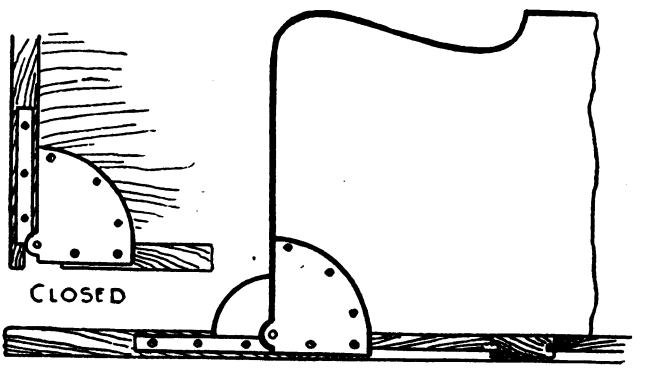
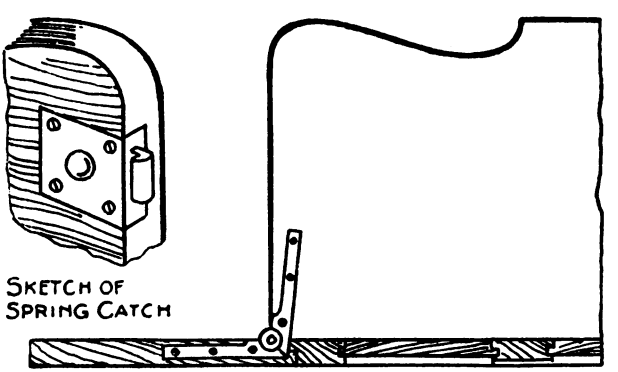
CONSTRUCTION OF A BOOKCASE

WITH SECRETAIRE AS DESK FEATURE

The secretaire bookcase illustrated herewith is an 18th century type, probably one of the most popular forms. There are various methods of supporting the writing fall of a secretaire drawer. The three which are illustrated are all satisfactory. The most rigid (which is a great consideration for the user) is A, as it is strong and there is scarcely any perceptible "play." The height of fall should not exceed 30 inches when in its position for writing. When



A



B

lining the fall and bottom with cloth, the fall should remain down, say for 12 hours, in order that it may set, otherwise

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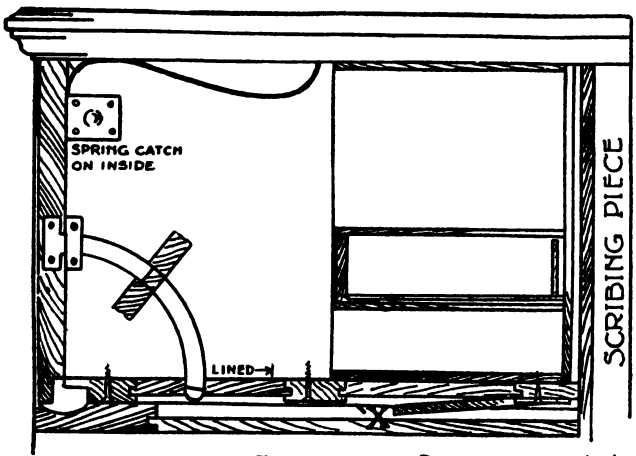
it is liable to become loose in the joint between the fall and drawer bottom.

The front and side rails of the framed bottom should be thicker than the other rails (say ⅛ inch full); this allows the drawer to pass over any little obstacle without grating.

The piece marked X on drawing C is fixed to the drawer bottom; its purpose is to prevent the drawer from being

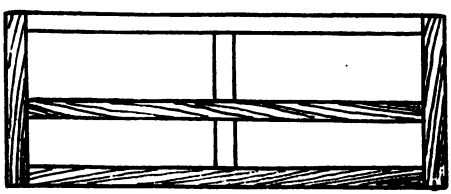


C

Drawer sides rebated for the bottom which is screwed into side.

pulled out entirely, and serves to stop it against the front rail.

Various ways of supporting the movable shelves in the top cupboard are shown. When studs are used, holes are bored ⅜ inch deep in the carcase ends 1¼ inch to 1½ inches apart to receive them and in the case of No. 1 the end is grooved the thickness of the plate, which is let in



SKETCH SHOWING FRAMED DRAWER BOTTOM
The shaded parts are of Hardwood, the other can be of inferior wood

flush with the end. No. 4 is a wood stud; the appearance of this is not so good as the metal stud, nor is it so strong, but it is, of course, cheaper.

The bar tracery presents difficulties to the beginner, but if handled properly and with care, it should be made a

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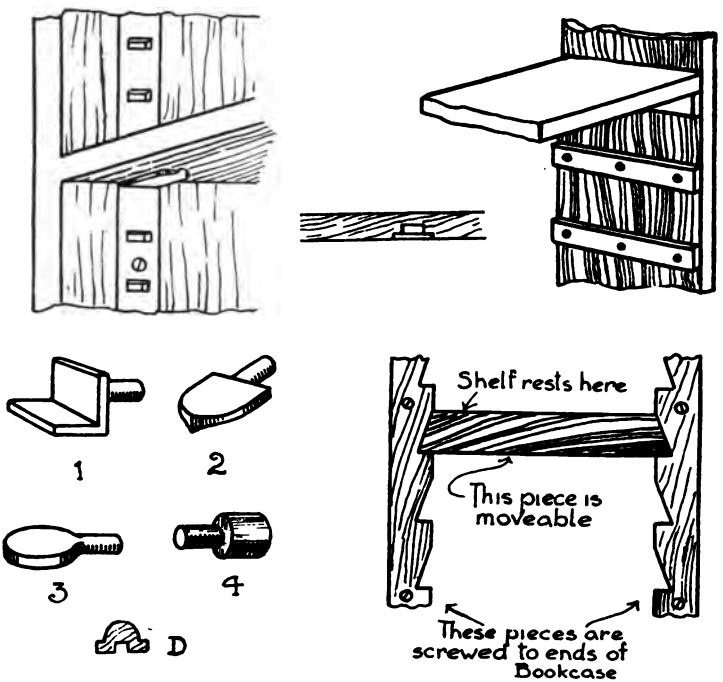
success. After the frame is put together, a piece of wood is fitted into the rebate and the pattern carefully set out on it. The mouldings which have been previously grooved (see D) are then mitred into position. If the bars are fitted snugly together without being tight and a touch of glue at each mitre, they will hold together while the pieces at the back forming the rebate are fitted, but when the bars are fitted together tightly, they are liable to fly up when released from the board. Pieces which form the rebate are



Showing Various Methods of Fixing Book Shelves in Place.

halved together where they cross and stub tenoned into stiles and rails. For shaped bars, the pieces forming the rebate are sometimes made of three veneers glued together between cauls shaped to the required pattern, but this is a rather expensive process. A quicker method is to steam pieces of English walnut (cut to size) which is very flexible, and will bend almost to any curve. If the article is of another wood, select light colored pieces which can be easily stained to the required color. In the bookcase shown, any wood could be used, seeing that the bars are straight.

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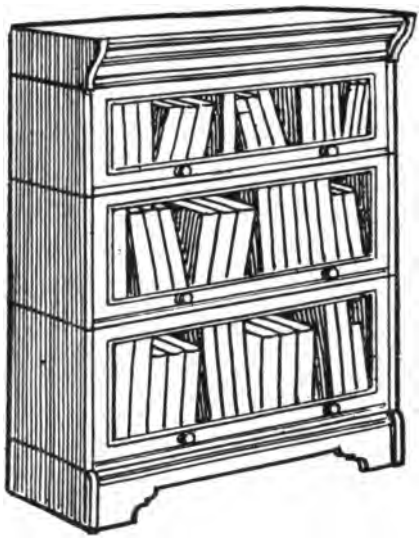

Perspective Sketch of a Sectional Bookcase.

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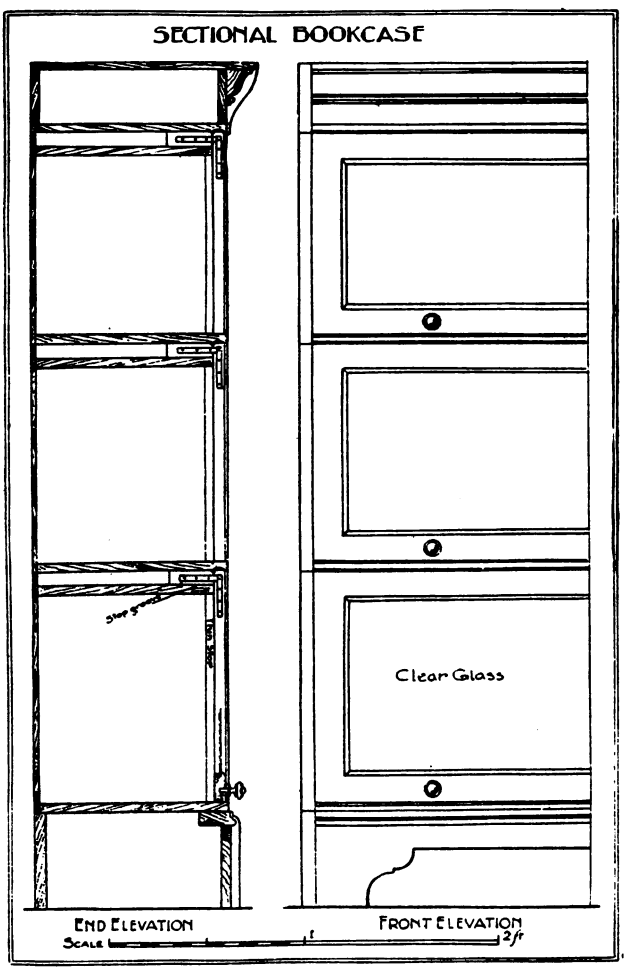
CONSTRUCTION OF A BOOKCASE

OF THE SECTIONAL TYPE

A type of bookcase which has become popular in recent years is the sectional variety, which possesses the decided advantage of expansion or reduction in size, by the addition



or removal of sections, each of such sections being complete in itself. The volumes are protected from dust by glazed

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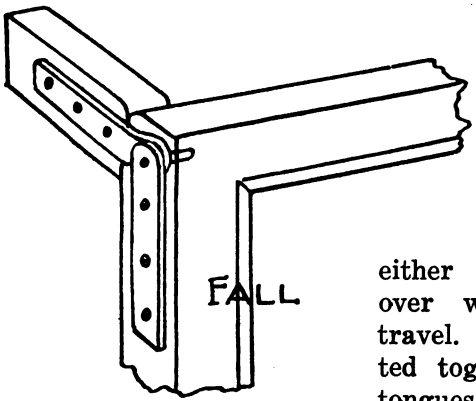
fall fronts, each of which is hung on a center hinge, on the pin of which it swings. The hinge is fastened to a tongued block, which travels in a groove in the carcase top, thus allowing the fall to be lifted up and pushed back horizontally while books are selected.

The groove in the carcase top is stopped a little distance from the front to obviate its being pulled out altogether. To assist the easy running of the fall it is advisable to put a small revolving roller at either end near the front, over which the fall may travel. The sections are fitted together by the aid of tongues and grooves, and the ends are made quite flush without any projections whatever, so that the carcase ends of two adjacent sections stand close together without any space between them.



The metal plates are let in flush, but are shown as above to illustrate the working of the centre.

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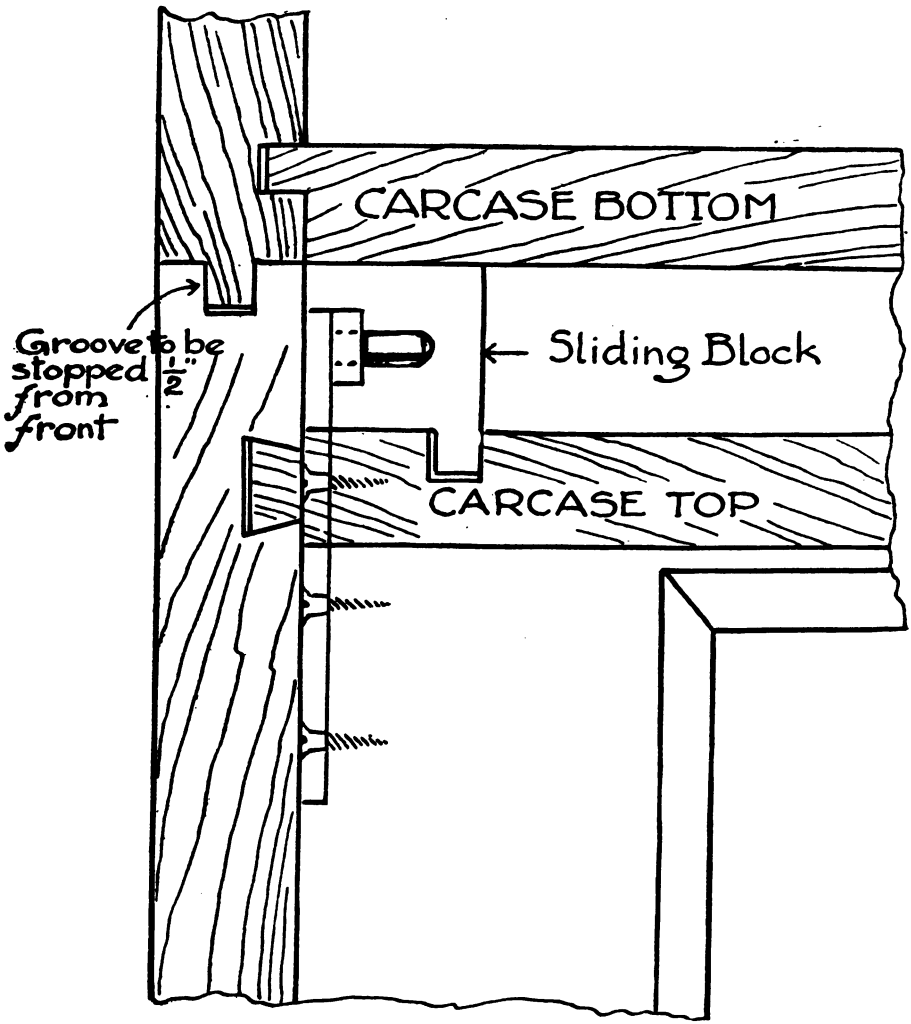

FULL SIZE FRONT SECTION SHOWING DIVIDING OF CARCASES ETC

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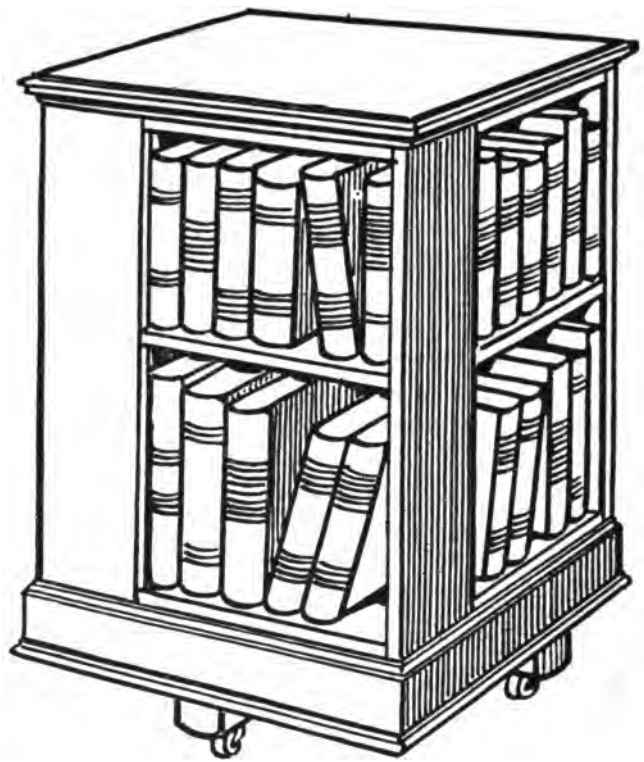

Perspective View of Revolving Bookcase.

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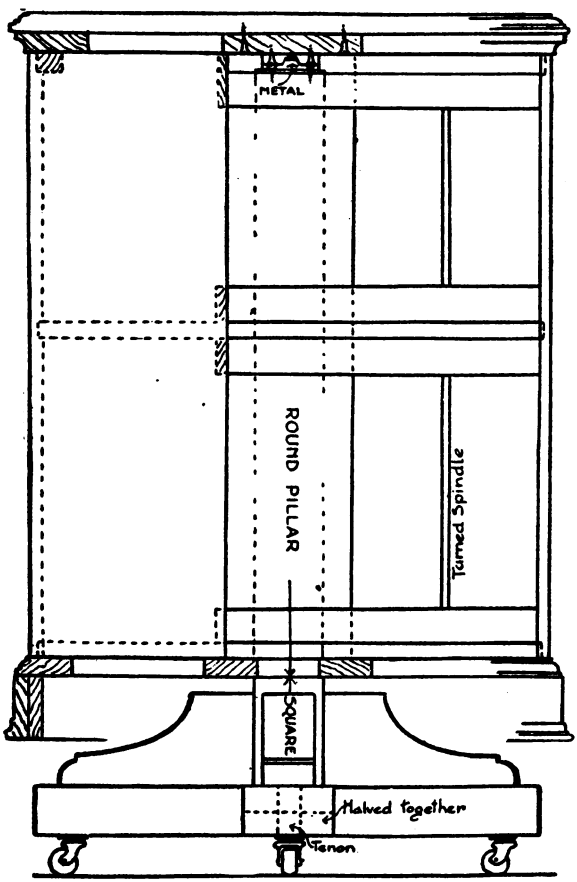
CONSTRUCTION OF A BOOKCASE

OF THE REVOLVING TYPE

Although there are various ways of constructing a revolving bookcase, certain main principles should always be observed. In instances where economy is a consideration,



Sectional View

the center pillar is not boxed in and the cross rails or book stops protect the books from coming into contact with the pillar when the bookcase is revolving. The center pillar is capped with a piece of metal with a raised beveled disc,

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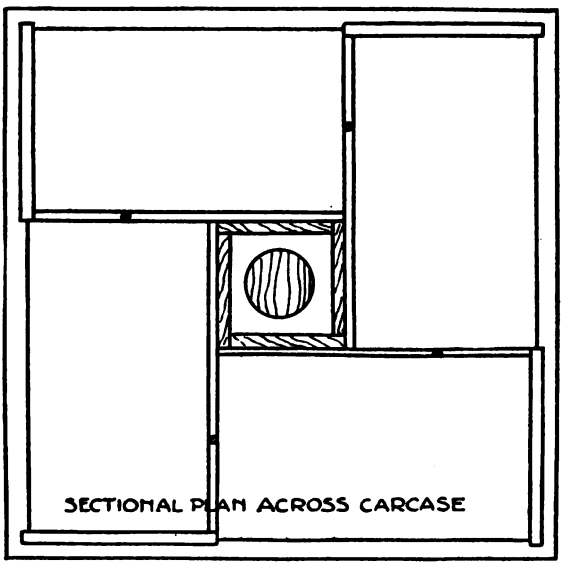
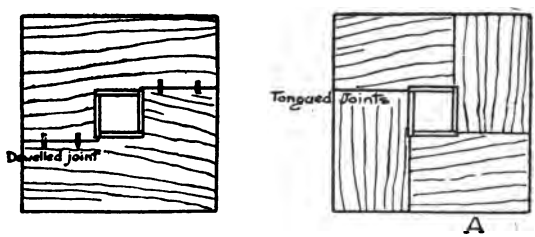
which exactly fits a cup-like sinking in another piece of metal which is fixed to a cross rail underneath the top. A wood pin is sometimes employed, but this could never be entirely satisfactory for any length of time as the great friction caused by supporting all the weight here must of necessity wear away the wood, and further, if the weight is not equally distributed, it will wear unevenly. A groove



is turned in the pillar at the bottom and two cross pieces are fitted into it for the purpose of steadying the book-case when it is revolved. The pillar should be tenoned into the base (the tenon being wedged) and further supported by four shaped brackets in order to make the stand or base



Sketches Showing Method of Jointing Shelves.

secure. Casters are placed at the extremities of the four arms of the base. The shelves are generally constructed as illustrated at A, four separate pieces being tongued together, but the alternative method of dowelled joints is

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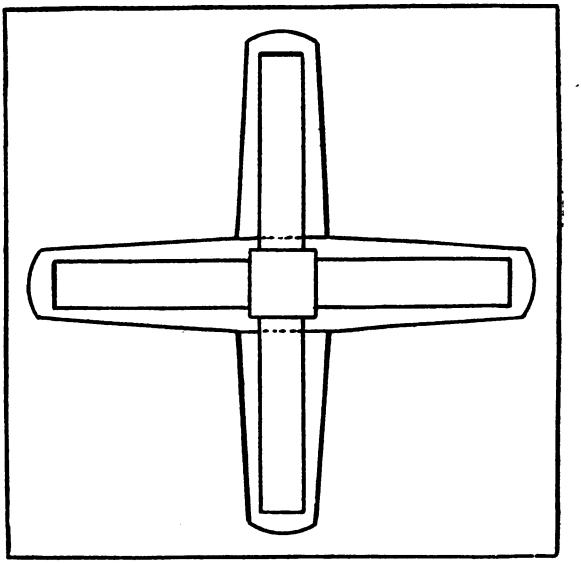
the easier if the bookcase is being made by hand. The shelves are held in position by grooves in the center box and screwed or dowelled to the pilasters which are also slightly grooved. The book stops which are fastened to the center box also assist in supporting the shelves. It should here be pointed out that if the box is grooved, the shelves must be built round it, rather a difficult and inconvenient



Plan under Plinth.

process. The general method employed, therefore, is to support the shelves by the book rests only, in the center, outside support being obtained by the screwing or dowelling to the pilasters already mentioned. The outside pilasters lend themselves to various treatments and may be panelled, veneered or perforated. In inexpensive bookcases, a series of laths takes the place of the solid pilasters.

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Perspective View of a Writing Desk.

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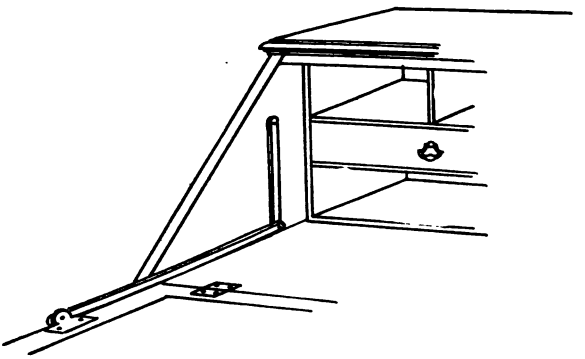
CONSTRUCTION OF A WRITING DESK

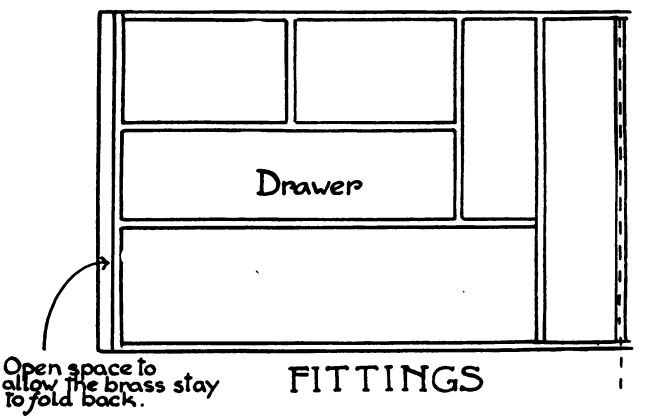
WITH A CHEST OF DRAWERS

As far as actual cabinet making is concerned, there is nothing that is not quite straightforward in the construction of the writing desk, working details of which are given



Sketch Showing Desk Open.

here, with the exception of the question of saving of material in the turned legs. There is no necessity to get the leg out the full size of the large projection at the top. This



Sketch Showing Arrangement of Interior of Desk.

feature can be more economically formed by first turning a groove in the leg to take a ring the size of the required member. A block is turned with the inside diameter slightly

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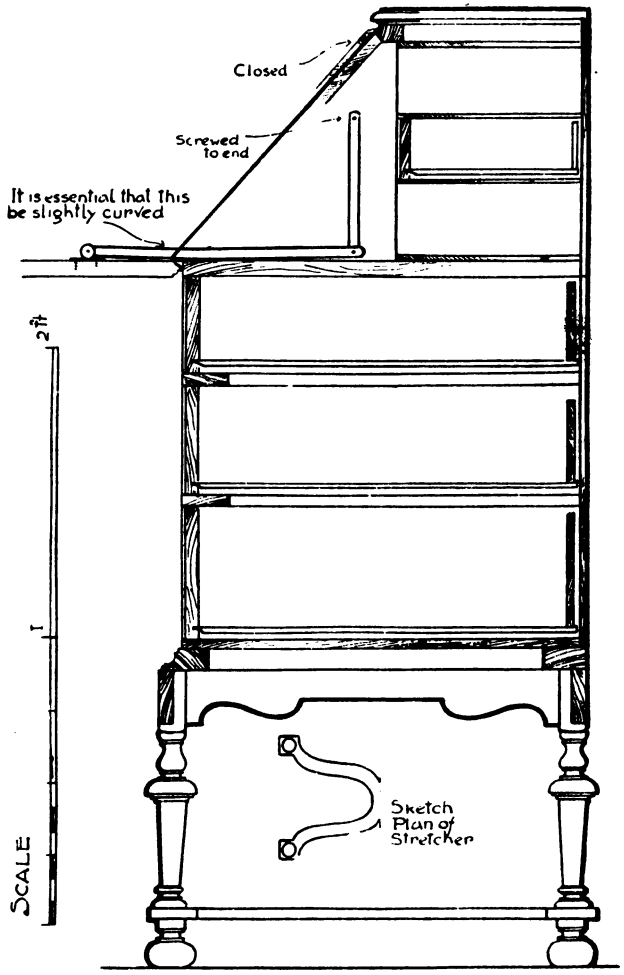

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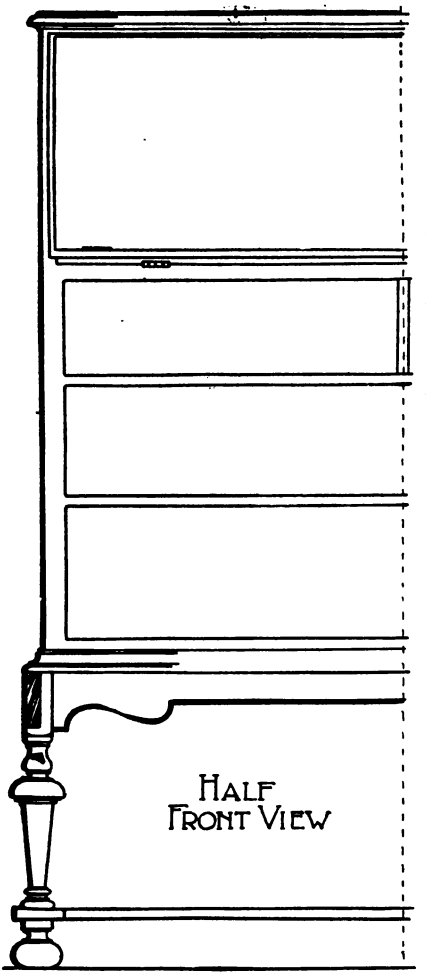
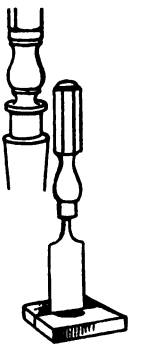
larger than the part round which it fits. It is then split with a thin chisel and glued and hand screwed in position round the groove. If any bruise is caused in splitting, it will be covered by the projecting member (see sketch). It may be argued that it is simpler to apply four blocks and turn the whole complete, but this was never done by the cabinet makers of the Queen Anne period, although the work was often carried out in this way in Jacobean and Elizabethan work. The writing fall itself is supported when open by a hinged metal arm acting as a lever, the short arm being attached to the carcase end, and the long one to the fall itself. Space is left between the stationery case and the carcase end to allow clearance for this brass stay when the fall is closed.





A point which should be emphasized is that it is essential that the long arm should be slightly curved with the concave side upwards, the reason for this being that when pressure is exerted on the fall, it is transmitted to the screw above. This method does away with the necessity of sliders to support the fall.

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Perspective of a Roll Top Desk.

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CONSTRUCTION OF THE ROLL-TOP DESK

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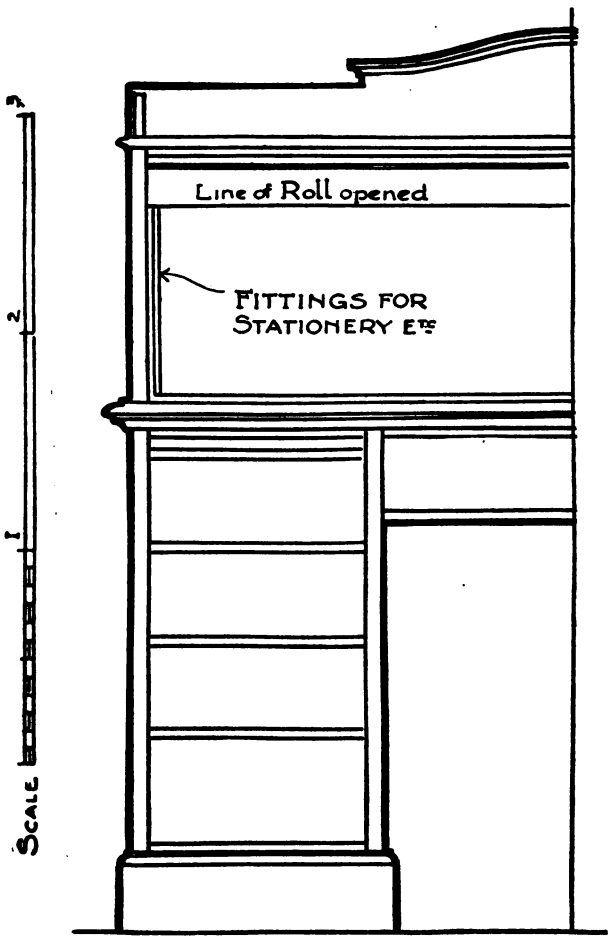
The accompanying drawing of a roll-top desk shows an effective and strong method of locking all the pedestal drawers with one action (*i. e.*, closing the roll), and at



Showing One-Half of Front View.

the same time allows any drawer which may have been left open to be pushed home and locked without again unlocking the fall. The arrangement consists of a square wood

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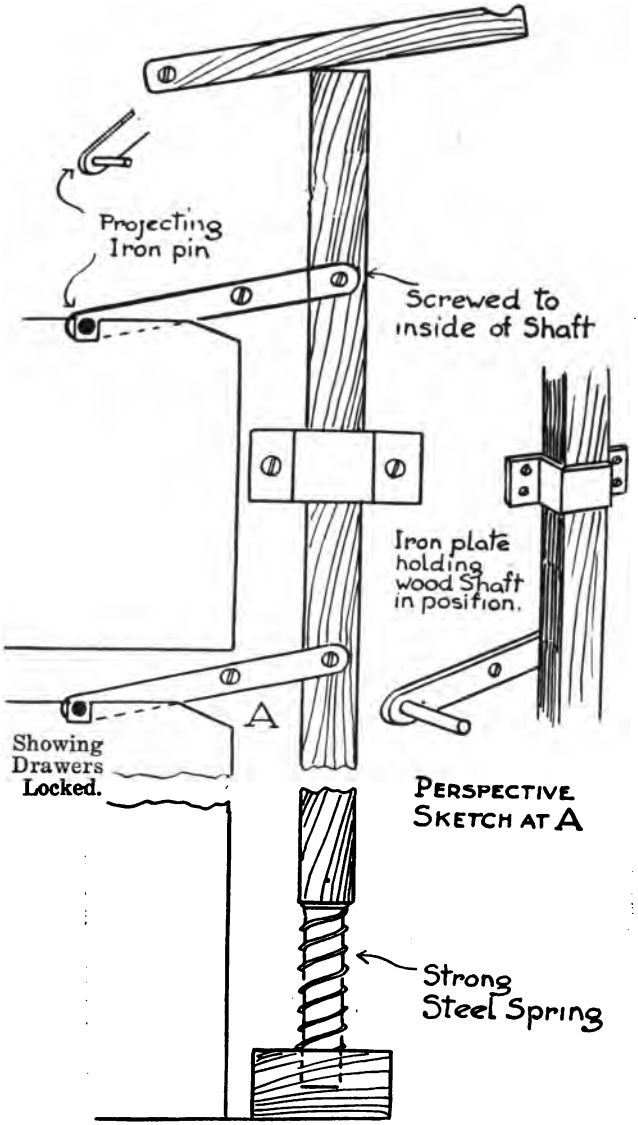

Machanism of the Locking Device.

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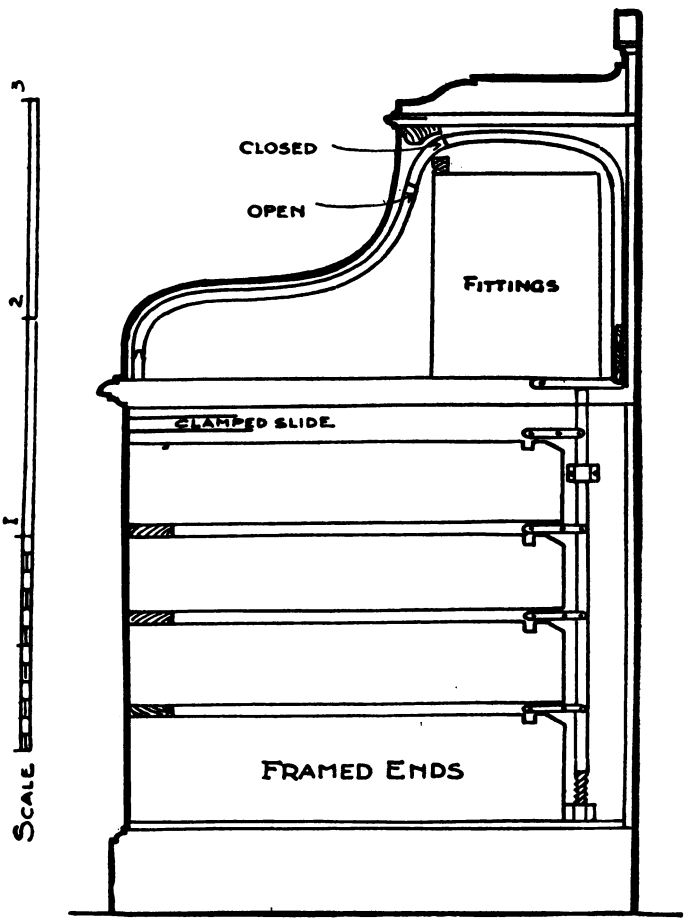

Side View Showing Drawers Unlocked.

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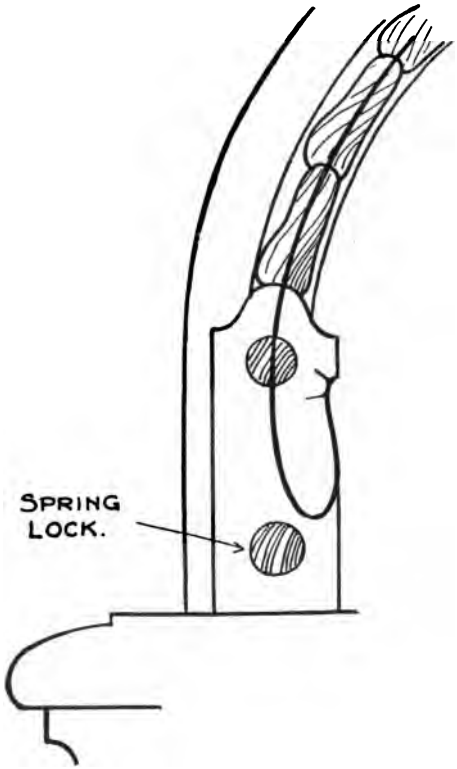
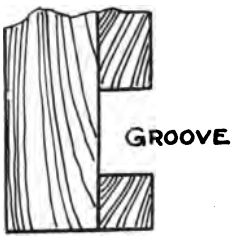
shaft with a round pin at base, fitted loosely into a block at bottom and held in position at top by an iron plate, which allows the shaft to move freely up and down. Attached to the inside of shaft are iron plates with projecting iron pins, which drop into slots cut in the drawer sides. The plates swing on screws put through them and fixed into the end of the desk. Immediately the fall is raised at back, when being closed, the spring at bottom pushes up the shaft and the pin ends of plates are lowered and the pins fall into slots cut into drawer sides. When the fall is opened it pushes down the horizontal piece (which is screwed loosely



Section Showing Roll.



Section of Groove to take Roll.

at one end) on to the top of shaft and forces it down. By this action the pins are raised and any drawer can be pulled out if desired. The two shafts are fixed against the outside ends of the pedestals. It will be observed that the action is very simple and strong, without intricate detail that is liable to get out of order. The laths which make the

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roll are strung together either with strong 1½ inch webbing or catgut, the latter being the most durable. In the locking piece at bottom of fall the end sections of two dowels are shown; these enable it to turn the corners more easily than if a tongue were used.

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Perspective View of a Kidney Shaped Writing Table.

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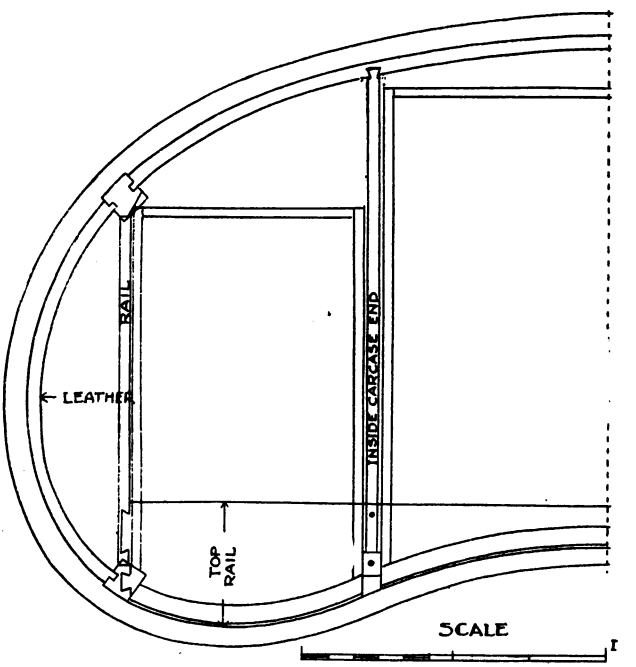
CONSTRUCTION OF A WRITING TABLE

OF THE KIDNEY SHAPED PATTERN

Wood, from its straight-grained nature, is best used in furniture which takes a rectangular form, and therefore curved work is always expensive to carry out. There are, however, times when it is necessary, and a kidney-shaped table is an instance of this. In setting out and constructing a table of this kind, the problem is to get the side drawers as wide and as long as possible, and therefore to avoid waste of space in the ends. To effect this in drawing the outline, care should be taken to make the ends as



Sectional Plan.

full as possible, always, of course, consistent with a good line. The general appearance of the front elevation is greatly improved if, in setting out the plan, care is taken to get the inside edge of leg and the opposite edge of end, parallel, thus making the shape of the drawer symmetrical

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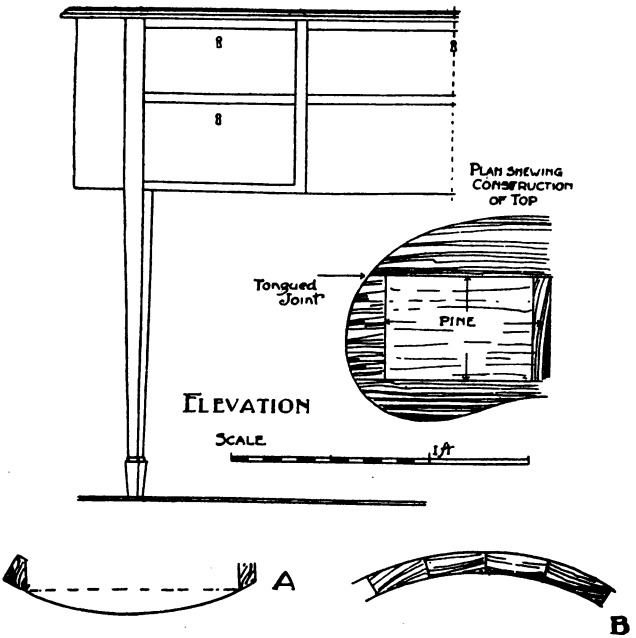
as at A. The shaped ends may be built up as shown at B, and veneered on the outside, this being the simplest and most economical method of construction for a single table. The wood margin or lipping around the leather or cloth (if the latter material is used) is formed by a band of thick veneer, the direction of the grain being at right angles to the curves.

The plan below shows the construction of the top before the veneered lipping, referred to above, has been applied. The pine panels shown are, of course, flush with the framing on the upper side. Difficulty is sometimes experienced in lining a top of this description, and the following notes may be helpful. The cloth has a tendency to



Details Showing Elevation, Construction of Top Before the Veneered Lipping is Added and Construction of the Shaped Ends.

spread and it should, therefore, be cut ⅛ inch smaller than the space it will occupy. Then glue the edge of the top to be covered, about two inches all round, afterwards covering the whole of the top with paste made from flour. The cloth being absorbent is liable to take up more than its share of the paste, hence the necessity for gluing the edge of the top.

We have already noted that cloth swells slightly; on the other hand, skiver shrinks about ⅛ inch, full, in four feet.

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Morocco swells about ¼ inch in four feet. These points should be very carefully noted, as nothing looks worse than leather or cloth which does not exactly hold up to the wood margin on a writing table.

It is sometimes necessary to remove grease spots from leather. This may be done by applying a little rubber solution with a clean rag. When this has evaporated the grease spot will have disappeared in the majority of instances.

The principles of construction involved in this kidney-shaped table would, of course, apply in equal measure to the under part of a toilet table or chest of similar shape. It is the aim of this treatise on practical cabinet making to deal not so much with everyday work, but with problems which present any unusual difficulty to the maker.

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Perspective View of a Library Table.

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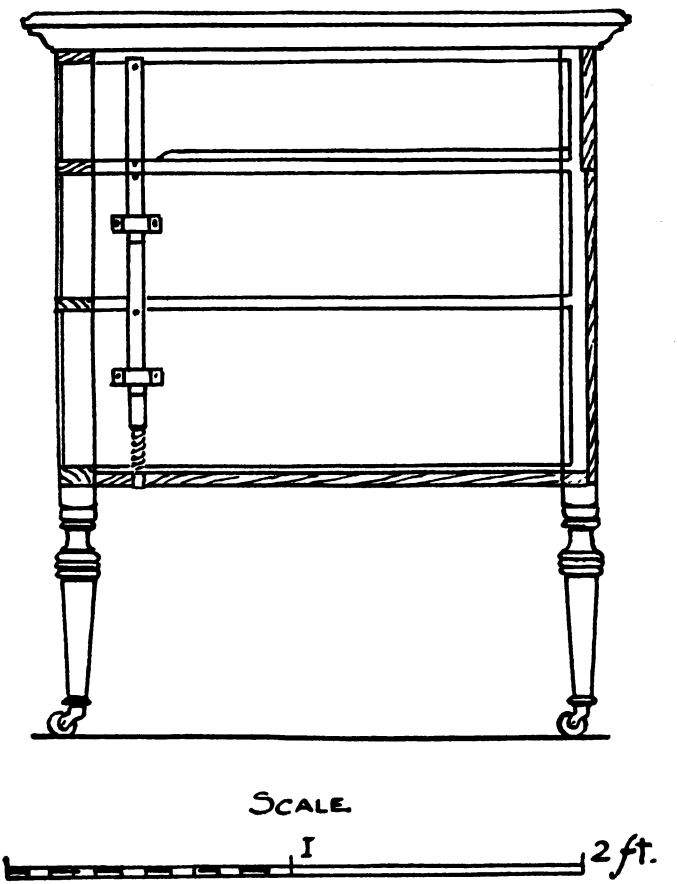
CONSTRUCTION OF A WRITING DESK

WITH AUTOMATIC LOCKING DEVICE

The automatic arrangement illustrated here has for its object the freeing or unlocking of all the drawers of a writing-table by the unlocking of the one in the center. This convenient arrangement effects a considerable saving of



End Elevation Locked.

time; the end in view is attained by a wood shaft, with a round pin at the bottom, held loosely against the inside carcase ends of the writing table by iron plates screwed

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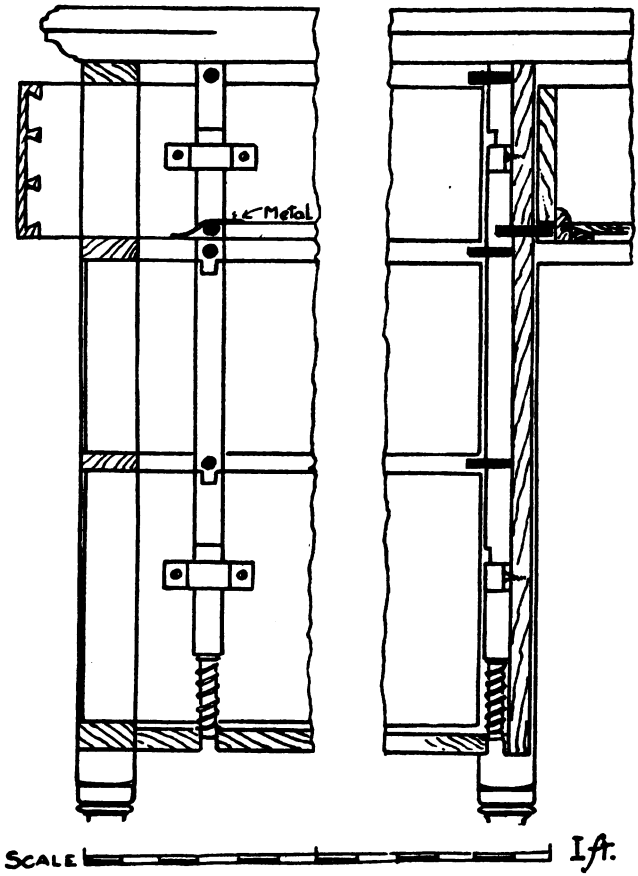
in position. Metal pins are fixed in the shafts, which fit into slots in the drawer sides when locked. An economical and strong pin can be made by driving in a medium-sized screw and filing it off above the thread. A strong steel spring fitted round the pin at the bottom forces the shaft up immediately the center drawer is open far enough and releases the side drawers. The shafts are notched to take



End Elevation of Front Unlocked

Front Elevation Unlocked

the iron plates, and this prevents the shaft rising too far and obviates the rubbing of the pins against the drawer bottoms above them. The bottom of the center drawer side is cut away enough to allow the pin to rise, except for a few inches in the front, as shown, and a piece of metal is fixed where the side strikes the pin. When the drawer is

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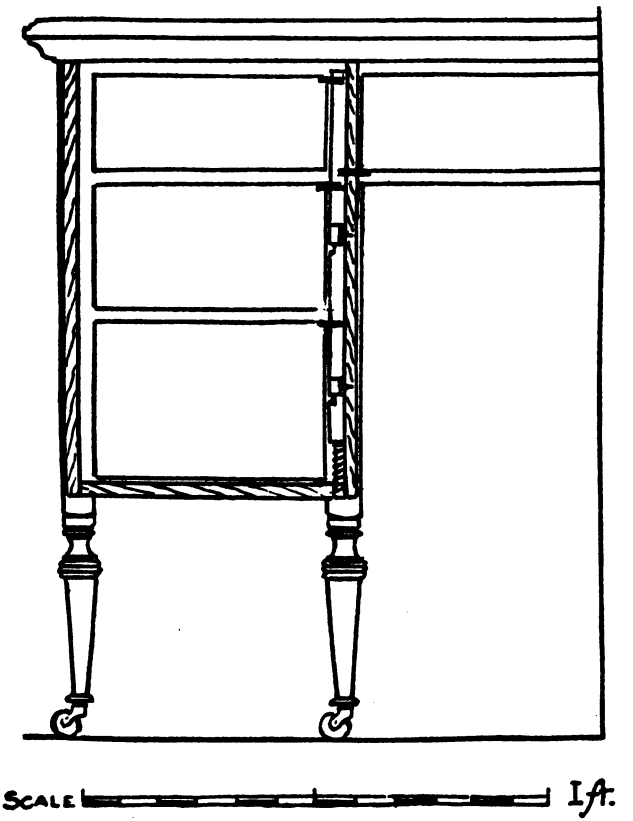
pushed right home this pin and the shaft to which it is attached, are forced down, and all the other drawers are at once locked if they are in position. To strengthen the center drawer bottom where the side is cut away, a strip should be glued on the inside. Our illustrations show the exact workings and positions.



Front Elevation Locked.

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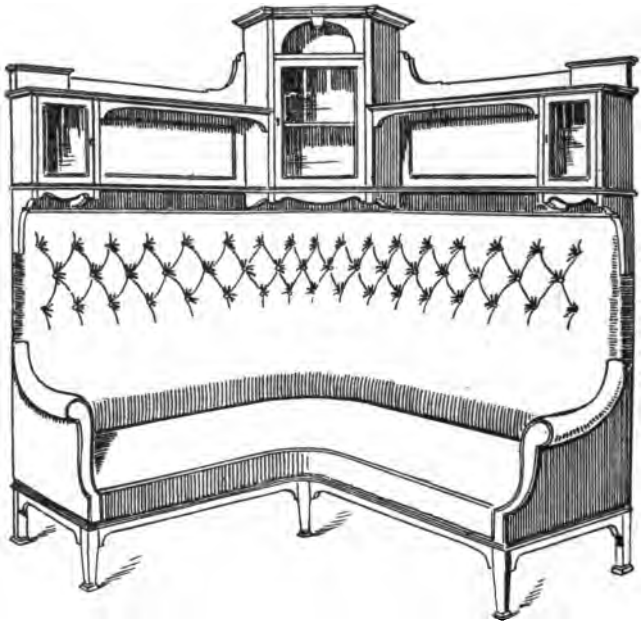

Perspective Sketch of Fitment.

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CONSTRUCTION OF A CORNER FITMENT

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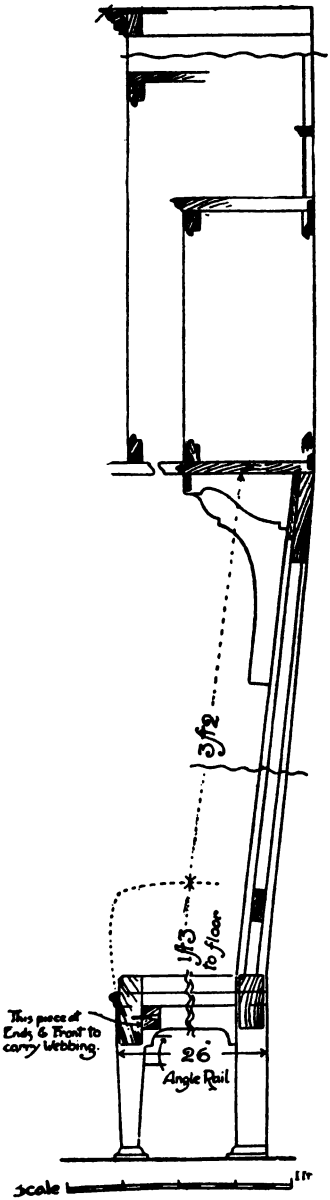

Side Elevation of Fitment.

Cabinet makers sometimes fail to grasp the essentials which go to make a corner fitment satisfactory from a constructional point of view. This is not to be wondered at, as it is a somewhat complicated problem which only has to be thought out comparatively seldom. The workman without previous experience of corner fitments is often nonplussed, because he has never considered the various points which should be embodied if complete success is to be attained. It goes without saying that the utmost care must be used in settling the out-to-out measurements, as a corner fitment usually has to fit in the recess either on the right or left of the chimney breast. The height and width of the seat must be arrived at having regard to the fact that the fitment will be used as a lounge, and that a deep, low seat is the one most conducive to comfort. In the construction of the seat it is essential that no cross rails should be used that are not absolutely necessary, and they should, if possible, be kept below the webbing; otherwise there is a tendency for the seat to become "hard" with use, from the

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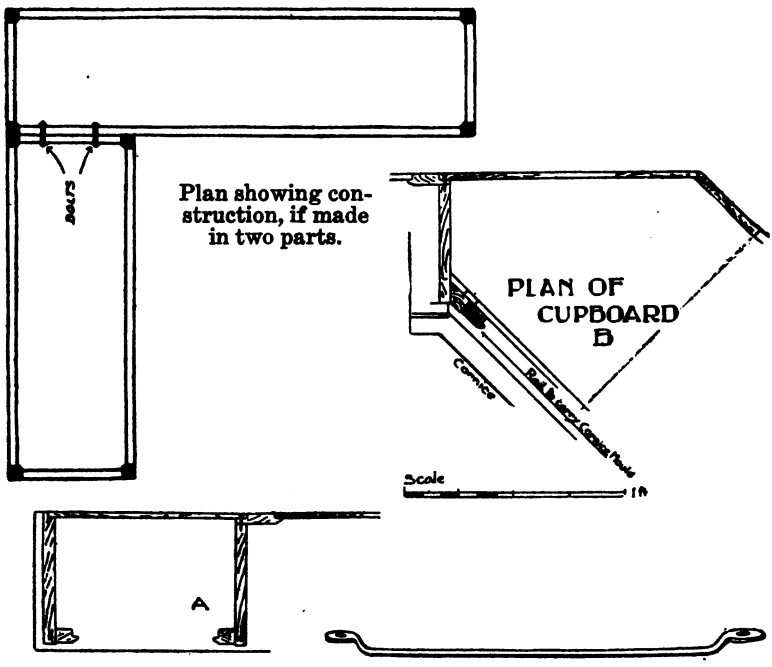
settling down of the upholstery on the rails, the seat thereby being rendered very uncomfortable. It will be seen in the example shown that there is one cross rail at the angle, and this is below the line of the webbing. In fitments where the seat is longer than the one illustrated, an iron stay bent as A is sometimes used to withstand the strain. If the back is splayed as shown in the sketches, the upholsterer



Plan of End Cupboard.

Sketch of Iron Stay A.

is able to effect considerable economy, as the amount of foundation necessary to build up the back to a comfortable angle is obviously lessened. It will be noticed that a right angle is avoided in the corner, which on plan is quarter circular. This also has the effect of saving material and at the same time adequate support is given to a person using the corner seat. Such a fitment as this should be made in two parts, divided at the moulded shelf directly above the upholstered back of the seat. In setting out a fitment like this, or in fact of any kind, it is essential to remember the dimensions of the average sized doorway, through which it will have to pass. If such a fitment could not be taken into a room in one piece, it should be con-

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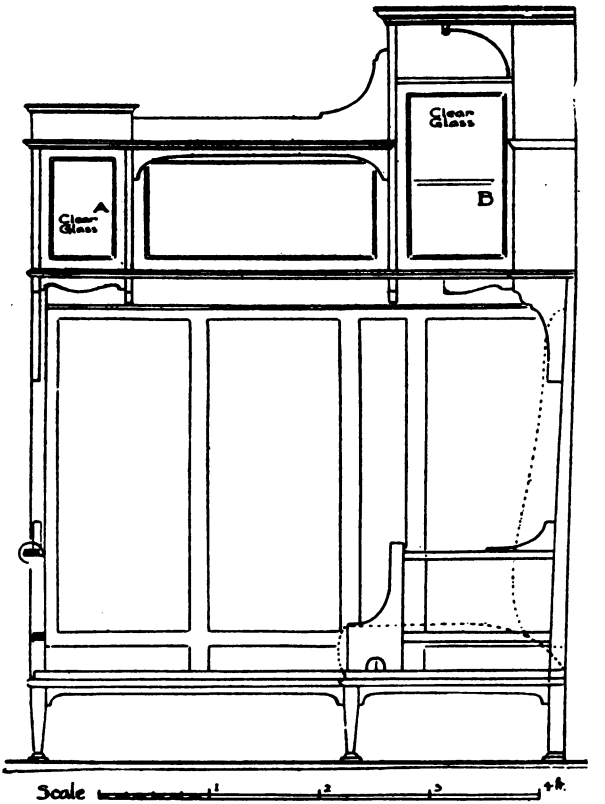
structed as shown in the small sketch, the meeting rails being bolted together. This is not advisable if it can be avoided, because it necessitates a joint in the upholstery;



the upholstered seat, if necessary, can be made loose and dropped into position on the framework. If this method of construction is followed, the finishing by the upholsterer will be greatly facilitated.

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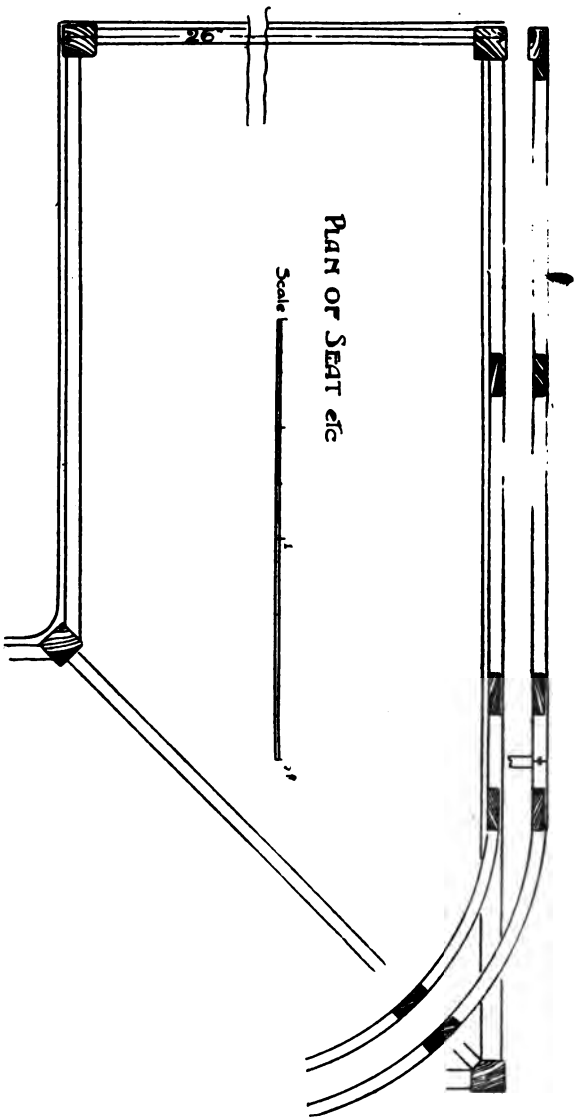

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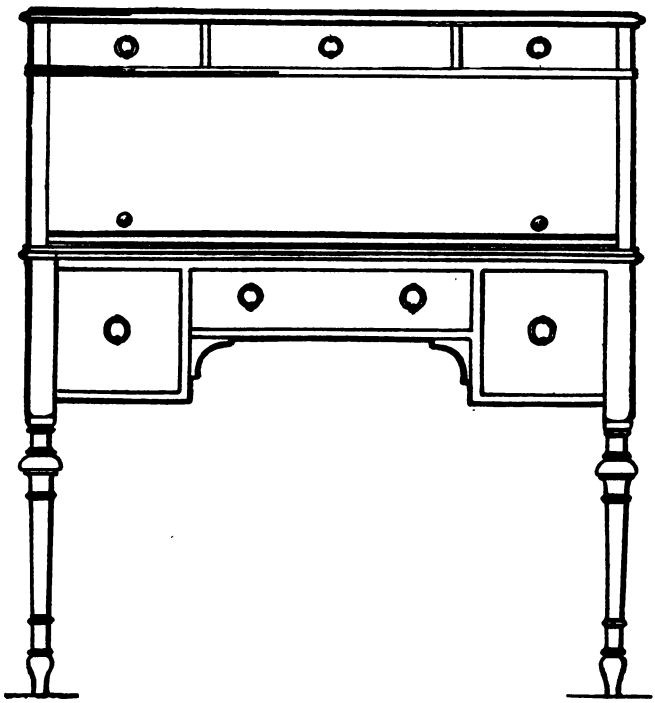

Front Elevation of a Cylinder Fall Writing Desk.

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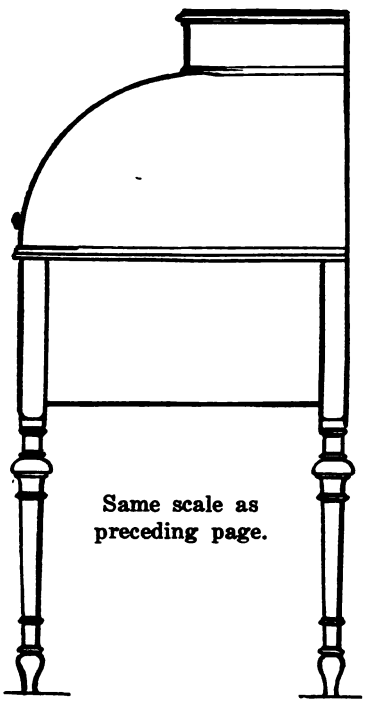
A CYLINDER FALL WRITING DESK

ITS CONSTRUCTION

Possibly the oldest form of a mechanical writing table is that with a cylinder fall, the action of which is somewhat similar to the one illustrated in Fig. 1. Of late years many other types have become popular, but the cylinder fall worked with trammel bars is still in demand: hence the necessity for detailing it. Its chief advantage is that one operation pulls the writing slide forward and raises the fall simultaneously, and by pushing back the slide the fall descends, enabling papers, etc., to be left undisturbed and locked away. The fall should be made out of narrow pieces, about 2½ inches wide, and tongue-joined together. A little care expended on putting these pieces together as near to the finished outline as possible, will be repaid in the shaping up. Tongues are cut on the edges of fall and the ends are grooved to receive them. Slotted bars or trammels are pivoted to the edges of fall near the back, and are similarly attached to the writing slide at each end. No fixed lengths can be given for these bars, as they vary according to the size of the fall, etc. To obtain the length and the center, set out the fall full size, and mark the position when opened, closed, and the bar perpendicular, as illustrated opposite, where they cross is the center for the fixed pin, about which turns the bar connecting the slide and fall. This also gives the length of the stop.



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End Elevation.

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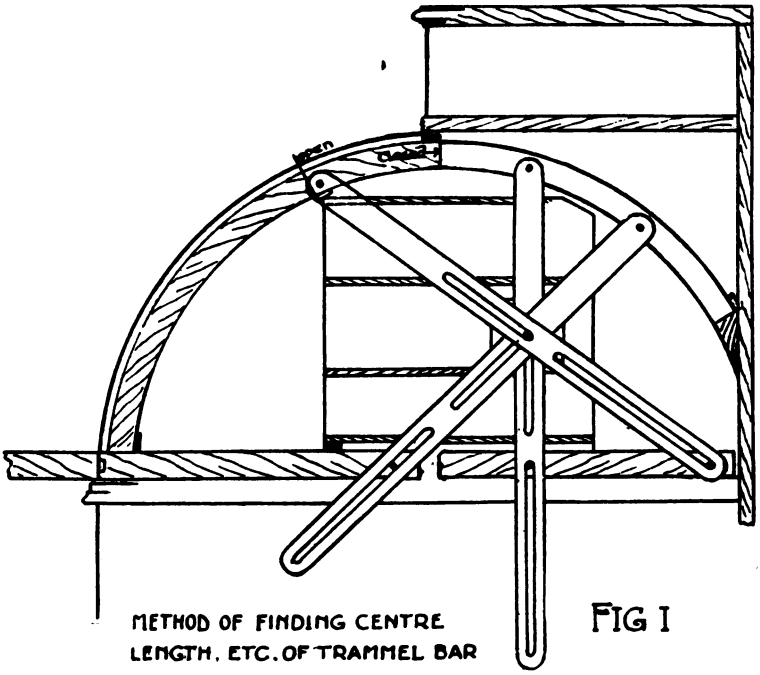

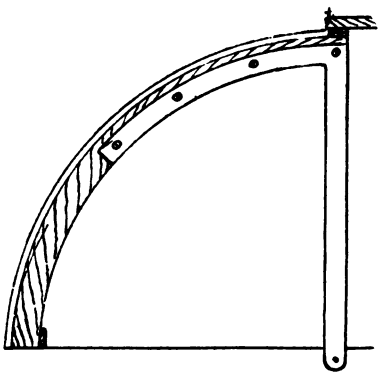

FIG 2

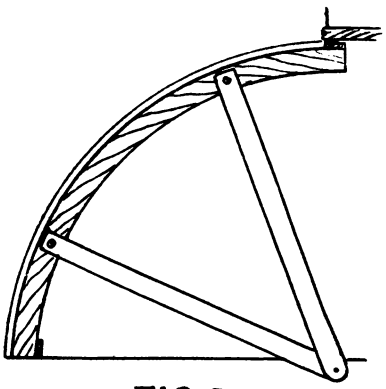

FIG. 3

Alternative Methods, Pivoted Falls.

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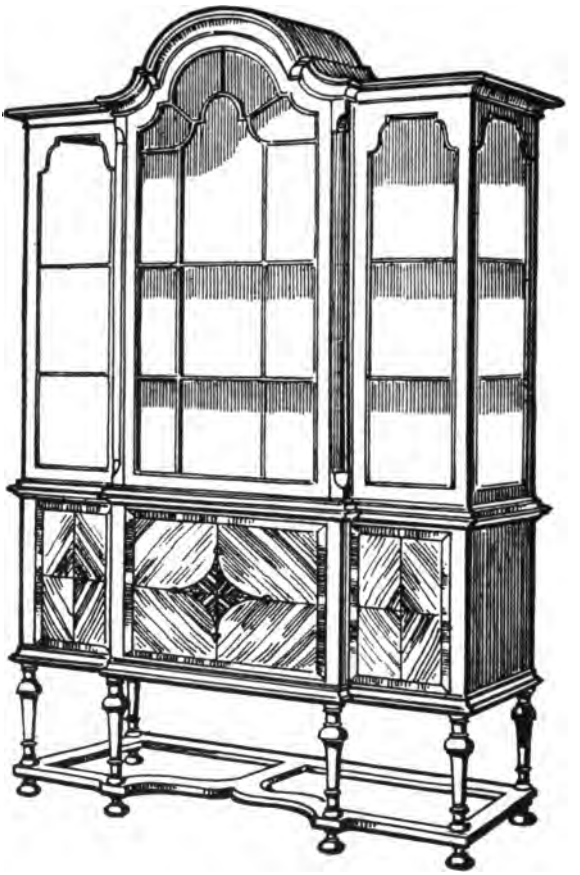

Perspective View of a China Closet, from the William and Mary Period

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CONSTRUCTION OF A CHINA CLOSET

AFTER THE WILLIAM AND MARY PERIOD

The proportions and detail of the china cabinet, the construction of which is illustrated and described in this article, are reminiscent of those embodied in the furniture produced during the reign of William and Mary. It depends on its outline and the arrangement of choice veneers for its decorative effect. Reticence is the great quality to observe in a china cabinet, which should enhance rather than detract from the specimens of porcelain which will be ultimately displayed in it.

The method of construction is shown in the plans and elevational drawings, but a short description of the lower cupboard doors will not be out of place. These are treated with fancy veneers, cross-banded and quartered, the doors are therefore constructed with clamped edges to keep them from warping. When veneer is quartered it pulls away from the edges and has a tendency to make any board or piece of wood concave on the side to which it is applied. To counteract this tendency, it is advisable to lay veneers on both sides, the grain of which runs at right angles to the grain of the panel itself. On this solid foundation the quartered veneer may then be laid.

The door should be hung with center hinges, then there is no unsightly brass work breaking the line and disturbing the effect of the cross-banded margins.

In the display cupboard shown are three movable shelves supported on brass studs. The holes for these studs are placed 1½ inches apart, the lowest hole being 7 inches from the bottom and the highest 7 inches from the top. The shaped top of the cabinet is made up of three veneers put together and bent on a shaped caul and afterwards screwed into position. The break of the cornice is formed by a thickening piece applied on a shaped rail which is dovetailed into the ends. There are no divisions in the upper part of the cabinet, the shelves running right through from end to end; this is the best method of construction, as when divisions are employed they cast dark shadows and much of the china exhibited is therefore lost sight of.

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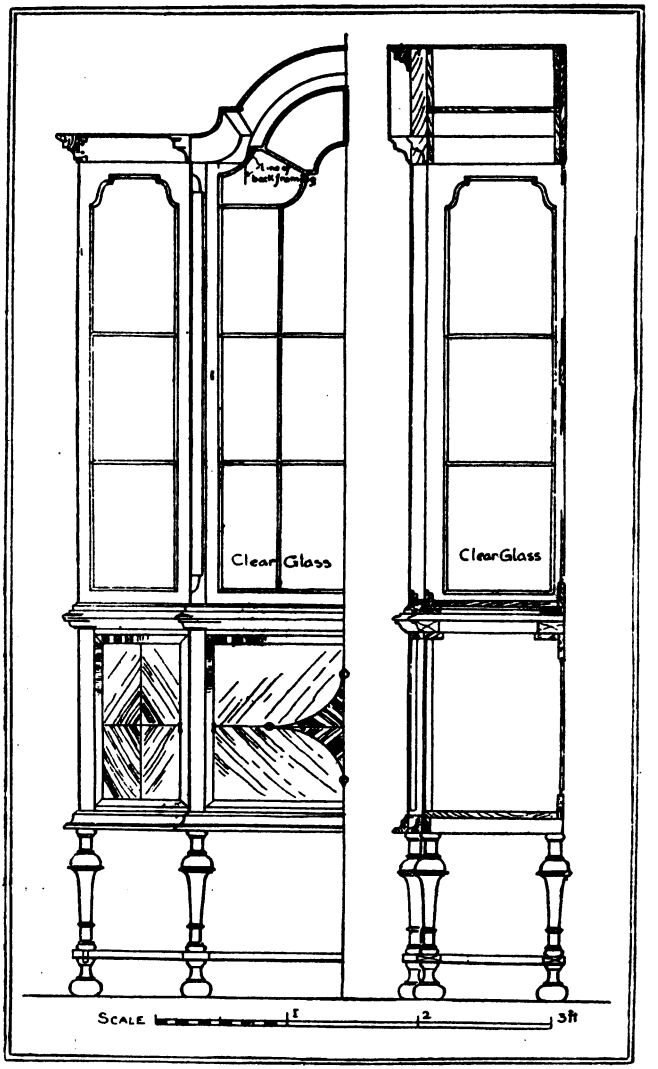

One-Half Front Elevation and End Elevation of the William and Mary China Closet

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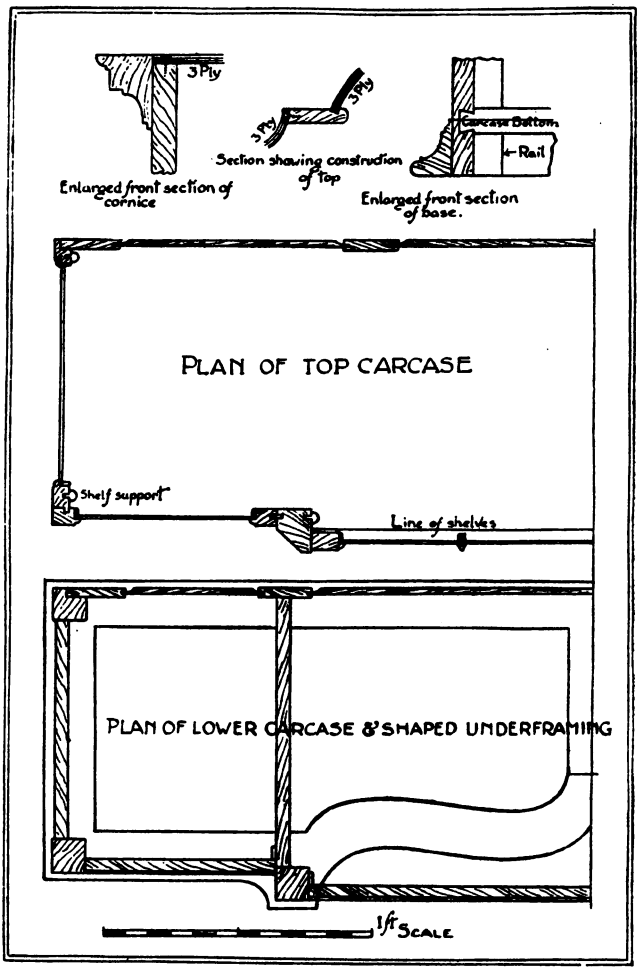

Plans and Details of the William and Mary China Closet

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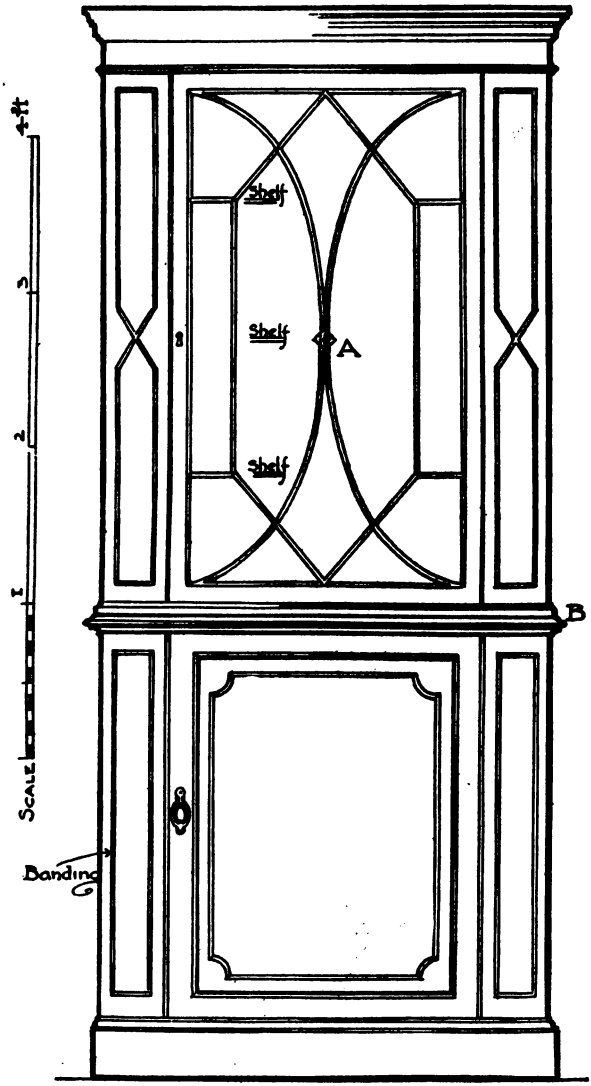

Front View of a Corner Cabinet

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CONSTRUCTION OF THE CORNER CABINET

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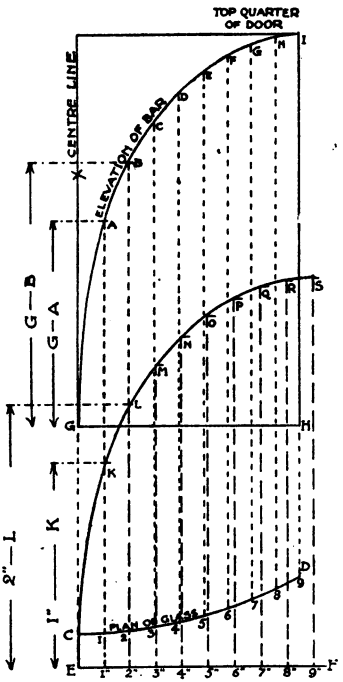
The making of a corner cabinet with a front which is curved on plan, presents many difficulties, perhaps the chief of which is the construction of the glazed door, as in these the doors are necessarily shaped both in plan and elevation. In order to accomplish this accurately, strike out a plan of the glass by making the sweep CD. Now set out on CD any number of equal parts "say 1 to 9," and raise perpendiculars which will cut the elevation of the bar at *a, b, c, d, e, f, g, h* and *i*. At any convenient position below the curve CD draw a horizontal line EF of unlimited length; and with the same distance in the dividers as was used to space out the line CD, set off 1″ to 9″ on the horizontal line EF. Raise perpendiculars from 1″, 2″, 3″, 4″, 5″, 6″, 7″, 8″, 9″ of unlimited length. Take the height G-*a* in the dividers and strike the distance 1″-*k*; then take the height G-*b* and strike off the distance 2″-*l* and so on. The points thus obtained 1″-*k*, 2″-*b*, 3″-*m*, 4″-*n*, 5″-*o*, 6″-*p*, 7″-*q*, 8″-*r*, 9″-*s* will give the requisite points for plotting the curve ES which will be the true face template for the bar. The glass would be made in one piece, and the bars held to the glass with seccotine and secured with screws from the back. In connection with the screws, small rubber washers should be employed. The carved patera in the center is for the purpose of holding the bars together where they meet, being scribed in position. A saddle, the same shape



Method of Securing the Proper Curve for the Front

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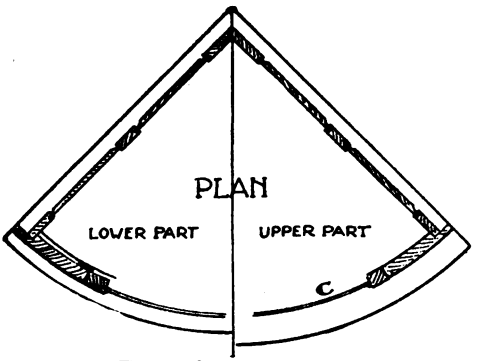
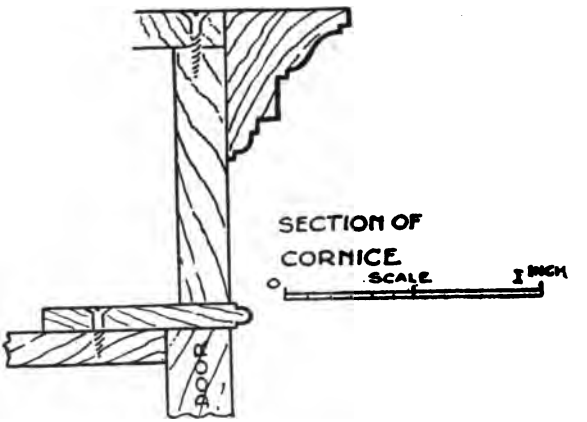
as the glass should be fitted into the rebate of door and on this the various pieces of tracery are fitted. After the face shapes are cut, the pieces should be glued down (with paper between the joints) to hold them while the required moulding is worked, most of which will be done with the scratch. This description applies to hand work only; the moulding



For scale, see page 142



Some of the Details of the Corner Cabinet

can be worked on a French spindle, using a saddle and working from the edges, doing half the moulding with each operation. If the door is made with bars at the back of the moulding in order to form separate panes a little extra strength might be gained, but the cost will be greatly increased. The back pieces would be made from three veneers glued together, and the moulding grooved and fitted over them. There would be no structural advantage in

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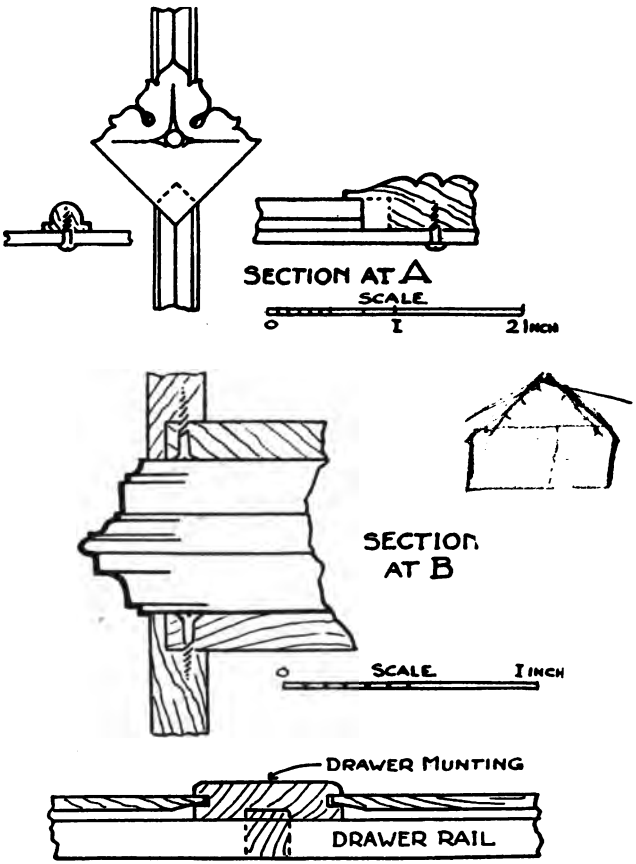
the use of a center patera in this instance, and it could, therefore, be omitted. When a door constructed in this way is completed, it should be sent to the glass manufacturers to have each pane fitted. By this method the glass is held in position by putty. The curved panel in the lower part should be of mellow stuff about ¼ inch thick, veneered



More of the Details of the Corner Cabinet

both sides, the veneer being laid between cauls, the shape of which exactly follows the line of the rebate of the door. A panel treated thus will retain the required shape. Sometimes a drawer is introduced into a corner cabinet, and the plan necessitates a very narrow drawer, or in the event of the drawer being made wider the depth is very much curtailed, so much so that it is impossible to pull out the drawer very far without careful handling as there is not sufficient

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running space at the sides. This difficulty can be surmounted by placing two grooved muntings in the drawer bottom, which travel over guides fixed in the drawer rail.

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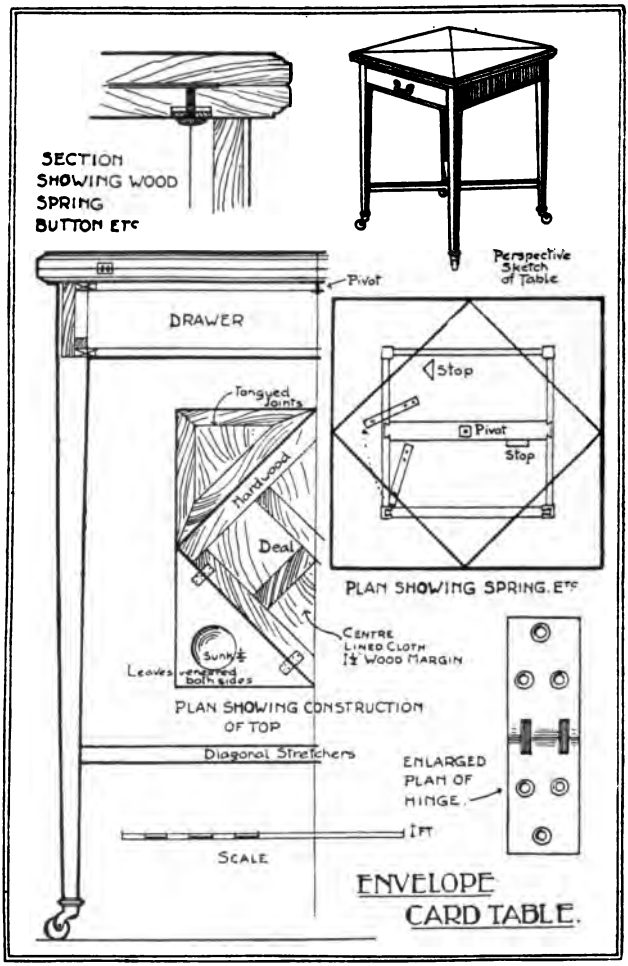

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CONSTRUCTION OF AN ENVELOPE CARD TABLE

PLAN AND DETAILS ON OPPOSITE PAGE

This type of table is square on plan both when open and closed, the four triangular-shaped pieces opening outwards, the construction being like that of an envelope, as the name implies. In order to give the hinged flaps support, the top revolves on a central pivot, so that the triangular flaps when opened rest firmly on the angles of the framework.

Unless some mechanical device is arranged it would be impossible to open these triangular flaps, as in a well-made table the joints would lie so close together. What is required is some automatic contrivance whereby one of the triangular flaps may be raised slightly in order that it may be gripped with the fingers and opened into position. To accomplish this a flexible wood spring is attached to the underside of the top, at one end of this a projecting button with a pin is fixed. When the top is revolving, this button on passing over the rail raises the pin and pressure is transmitted to one of the triangular leaves which is forced up just enough to allow of its being gripped and opened out.

The leaves are clamped to prevent warping, as it is important for the appearance of the table that they should lie quite flat when closed. Two stop blocks are fixed which prevent the top from revolving beyond its proper position. When the top is stopped in position, the sides should be parallel with the sides of the underframe.

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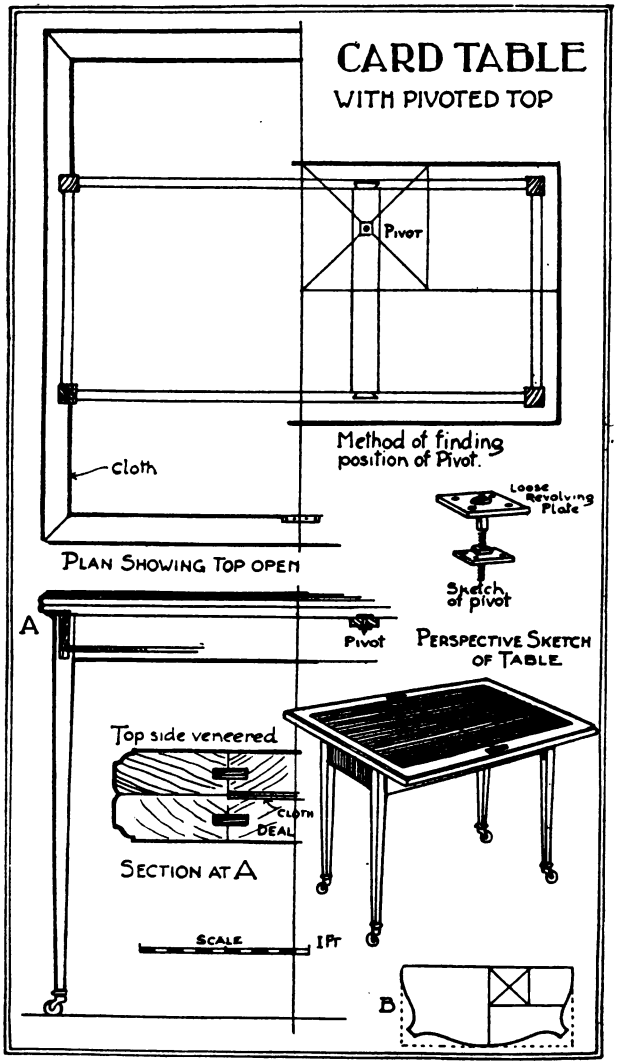

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CONSTRUCTION OF A CARD TABLE

WITH PIVOTED TOP

In order to save floor space, card tables are generally made with folding flaps, and the problem which confronts the cabinet-maker is the making of a table which is small and unobtrusive when not in use, but large enough to be quite comfortable when open for play; at the same time the construction must be such as to ensure that the top is quite rigid. There are many ways of fulfilling these conditions, but the simplest is the one shown here. In this case, when the table is open, the area of the top is exactly doubled, and the two hinged leaves of which it is composed are at right angles to the position they occupy when the table is closed. The leaf which lies underneath when the table is not in use is held in position (but left free to rotate) on a screw and pivot. A cross rail, as shown on the plan, is dovetailed to the side rails of the frame, and through this runs the shaft of the pivot, the lower plate being screwed to the underside of the cross rail. The finding of the correct position for the pivot in relation to the top, causes the cabinet-maker who does not know the proper method of setting it out a good deal of trouble, but it is in reality a simple matter. First halve the under leaf and divide into four parts, take one of the quarters nearest the center line and divide it by diagonals as shown. Where the diagonals cross each other is the correct position for the pivot. This plan will work for any table, no matter what the size, and even if the outline is shaped it can be found in the same manner as shown in sketch B.

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Sketch of a Circular Card Table (Open)

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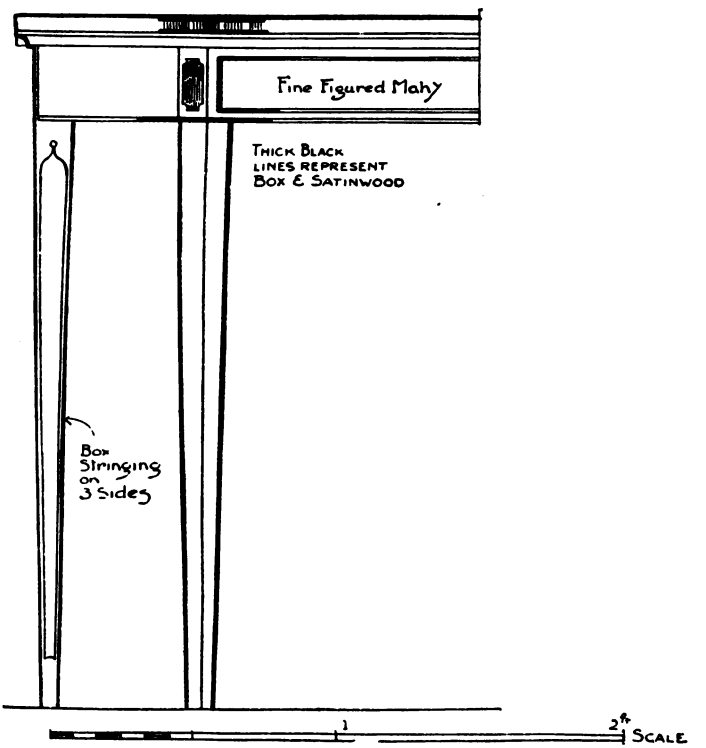
A CIRCULAR CARD TABLE

ITS CONSTRUCTION

The methods of construction shown in this card table are taken from an existing Eighteenth Century example. Its firm condition at the present day is good testimony as to the constructional principles employed. The formation of the semi-circular rim under the top shows an unusual method, but time has demonstrated its effectiveness. Another feature which should be noted is the fixing of the leg



Details of the Legs and Top

to this rim. It is haunched on the outside and inside and morticed in the center, making it very rigid. The back legs are fastened to fly rails, which are hinged by means of a knuckle joint. Present-day makers usually prefer a finger

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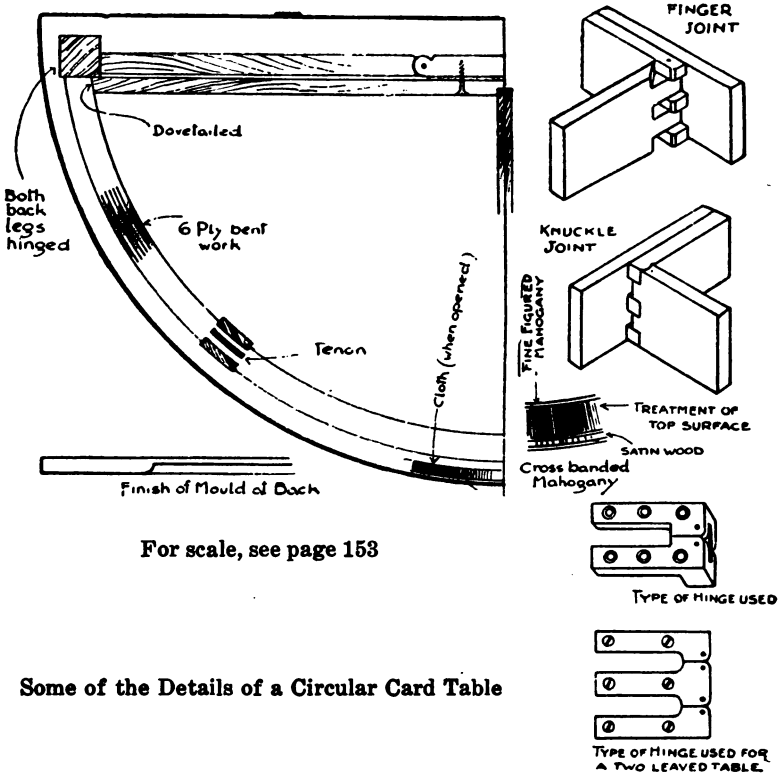
joint, which is equally strong, but not quite so good in appearance.

To construct a knuckle joint, strike out a semi-circle on the end of the piece, the full thickness of the wood, and round off the corners to these lines with a rebate plane. Cut away the parts between the knuckles, cramp together, and bore for the iron pin or pivot.



For scale, see page 153

Some of the Details of a Circular Card Table

The veneering of this table shows how such work can be used with fine decorative effect. The hollow moulding on the under side of the top, which serves to give it lightness of appearance, is stopped some distance from the back to allow wood for the hinge.

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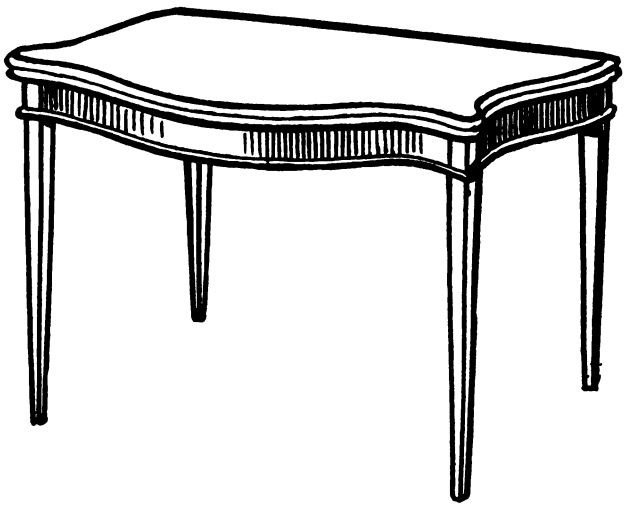

A Chippendale Card Table

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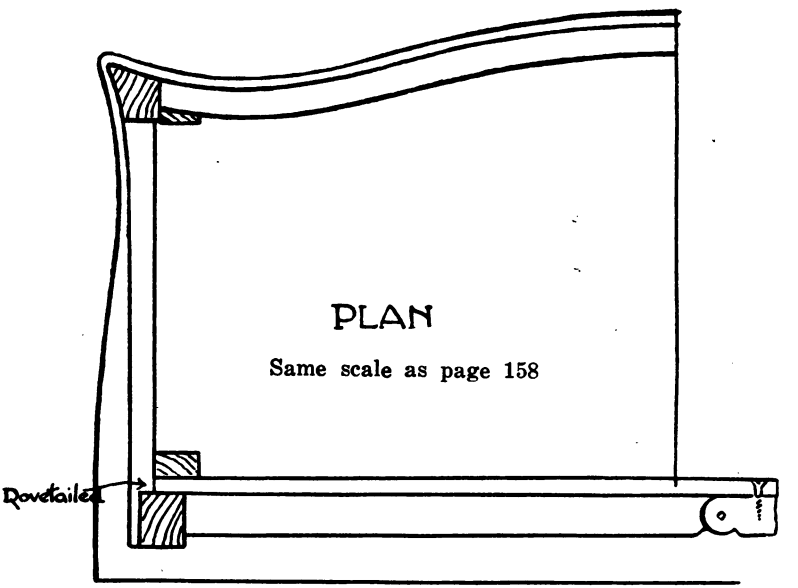
A CHIPPENDALE CARD TABLE

ITS CONSTRUCTION

The illustration on page 156 represents a form of card table popularized by Chippendale. The top should be veneered, a treatment which serves a useful purpose as it hides the joint of the clamped edges. End grain stuff is used for the clamping at the ends of the top. After the frame has been put together, the front legs and rails are



Plan of Top of a Chippendale Card Table

finally shaped and then veneered, the grain being laid vertically. The rail at the back which holds the frame together is dovetailed and the end rail is continued and rebated to receive the fly leg which is shouldered underneath; the leg at the other end is a fixture. In order to strengthen the corners, blocks are used as shown in the detailed drawings. A finished, neat appearance is given to the bottom edge of the rails by an applied bead, which is continued round the table. The legs have a black line about 1/16 in. square let in on each edge. It seems almost unnecessary

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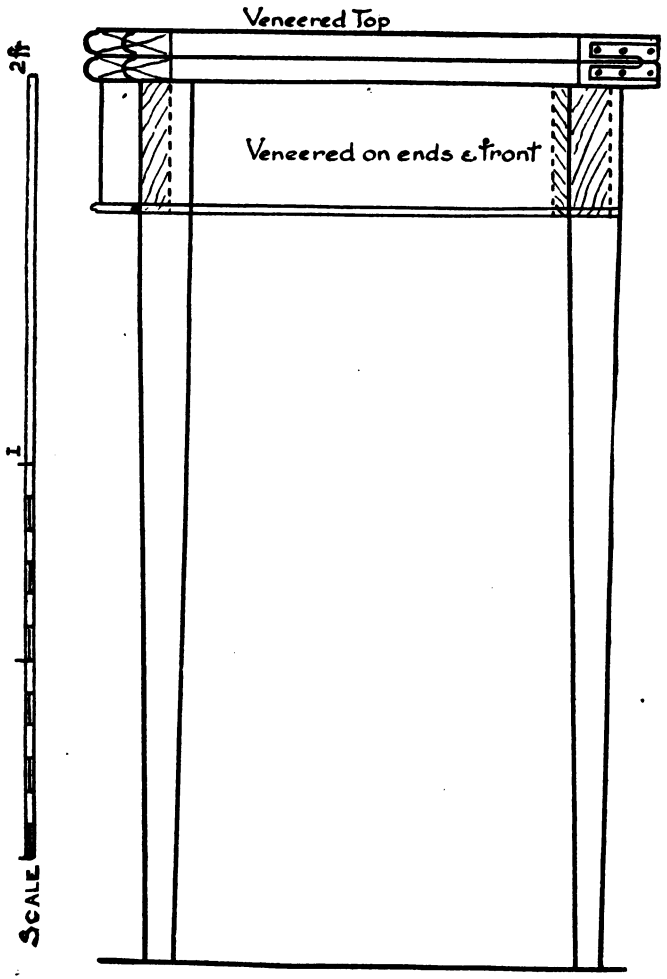
to add that a simple table like this depends largely for its effect on the selection of nicely-figured veneers for the top and rails.



End Elevation of a Chippendale Card Table

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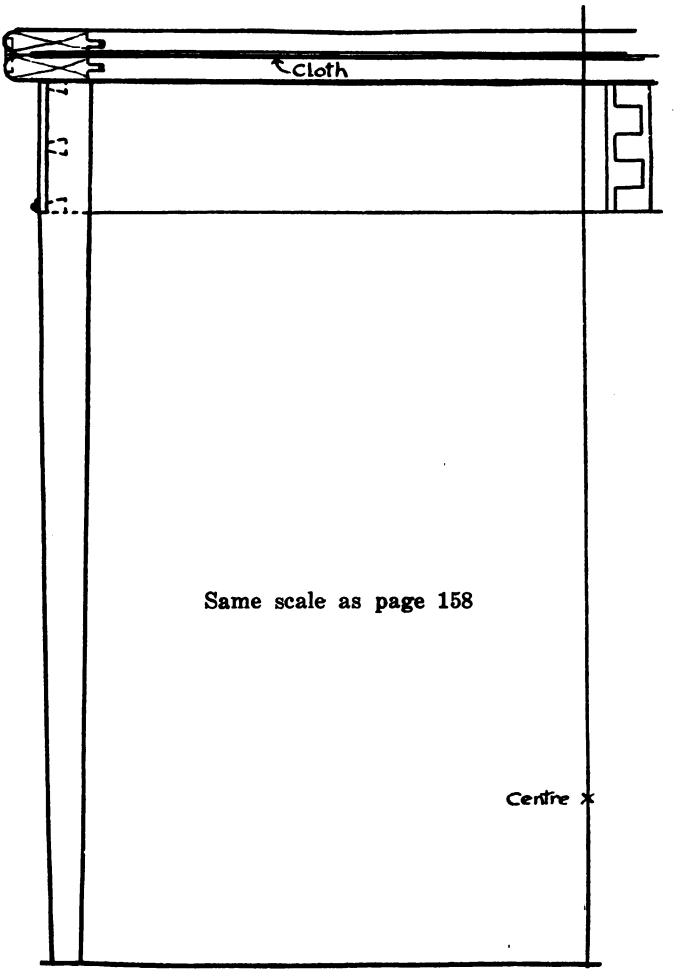

Same scale as page 158

Back Elevation of a Chippendale Card Table

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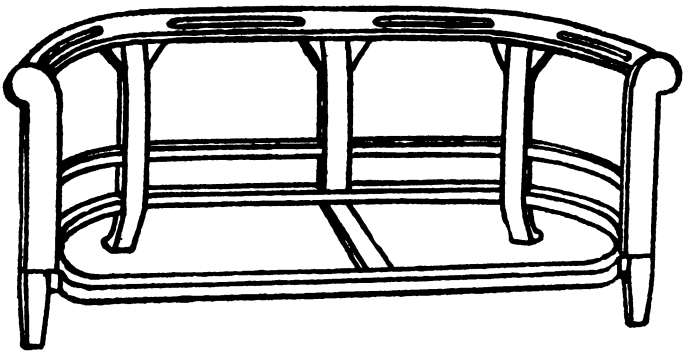

Perspective Sketch of a Chesterfield Frame

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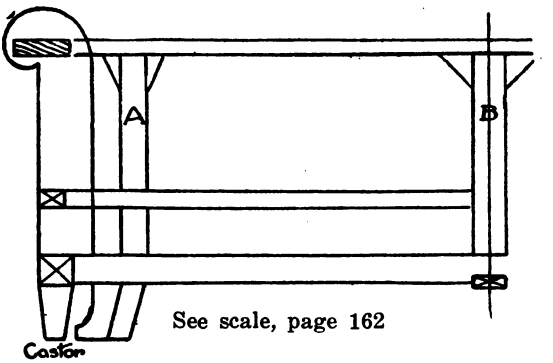
A CHESTERFIELD FRAME

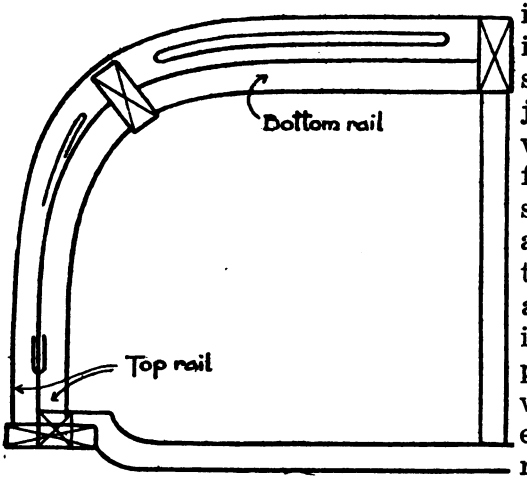
ITS CONSTRUCTION

Unfortunately, there is over-stuff work on the market which will not bear inspection, either as regards the quality of the fillings or the construction of the frames. It is very necessary that the latter should be properly made, strength being much more essential than a clean finish, as only the short legs will be exposed when the work is finally upholstered. In a 6 ft. Chesterfield there is considerable strain on the front rail and, as the scale drawings show, this should be of stout material. The point at which the frame is most likely to fail if not soundly constructed is at the junction of the legs with the underframe, but it will stand all the wear and tear it is likely to get if the legs are properly framed in, as shown on plan; the dowelling which is sometimes employed cannot be regarded as a satisfactory method. It will be noted that the stretcher between the back and front rails is fixed



See scale, page 162

Front View



See scale, page 162

Plan of a Chesterfield Frame

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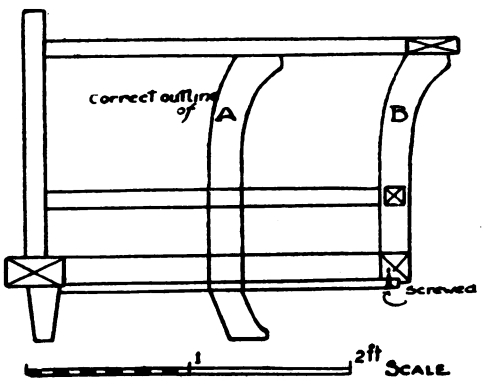
underneath, well out of the way of the springs. The top edge of the underframe should not be more than 7½ in. from the ground, otherwise, when upholstered, the seat will be too high. The slots in the top rail are to facilitate buttoning. Birch and beech are the materials usually employed for high-class frames.



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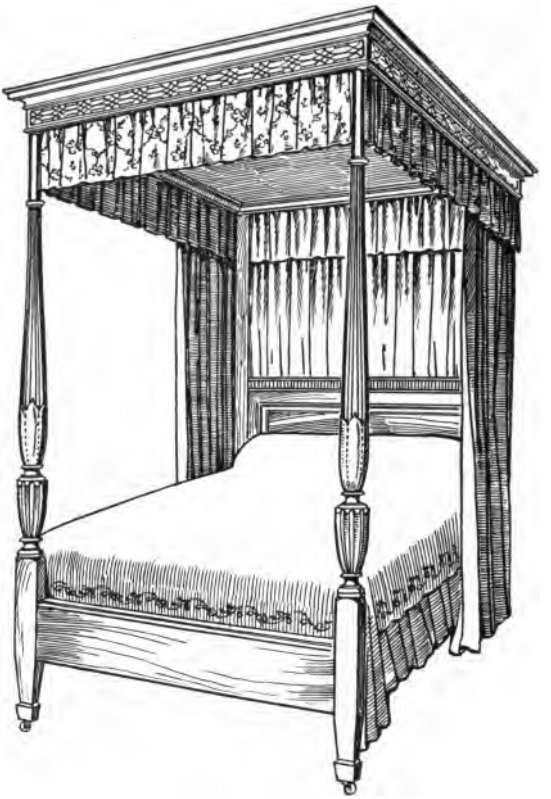

Perspective Sketch of a Four Poster Bedstead—18th Century Origin

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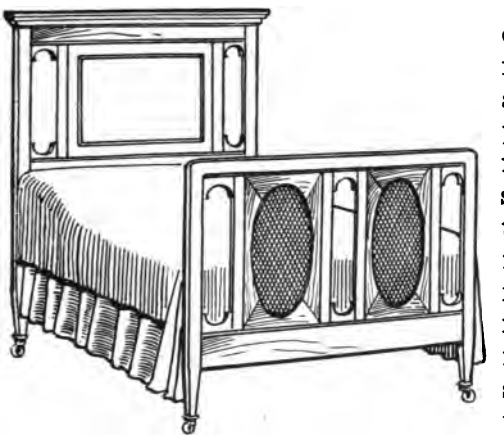
THE CONSTRUCTION OF BEDSTEADS

ILLUSTRATIONS OF THREE TYPES

The wood bed again figures largely in the furnishing of the modern bed-room, doubtless because it can be made to harmonize so successfully with the woodwork of the room. Apart, however, from its general character, comparing the modern wood bedstead with its predecessors, we find many improvements in construction. This remark applies particularly to the methods of fixing the sides to the head post and foot post. The four-poster illustrated closely resembles the examples in vogue in the 18th century when the bed was a much more important piece of furniture than it is today; the bed-room was then often used for the reception of friends, a fashion imported from our French neighbors.



A French Bedstead

There are many indications that the four-poster bed is again becoming popular; it will be noted in the one sketched, page 166, that although it is nominally a 4 ft. 6 in. example, it really measures 4 ft. 7 in. over the sides, the reason for this being that mattresses are often made full size, and over and above this they tend to spread in use; by making the framing wider than the mattress, the latter does not project beyond the foot and head boards. The height of the bedside varies with the type of mattress used, the governing factor being to have the top of mattress about 18 inches from the floor. There are many ways of fixing the sides to the posts; the old method of bolts and nuts has been superseded by the many forms of iron dovetails and sockets now on the market.

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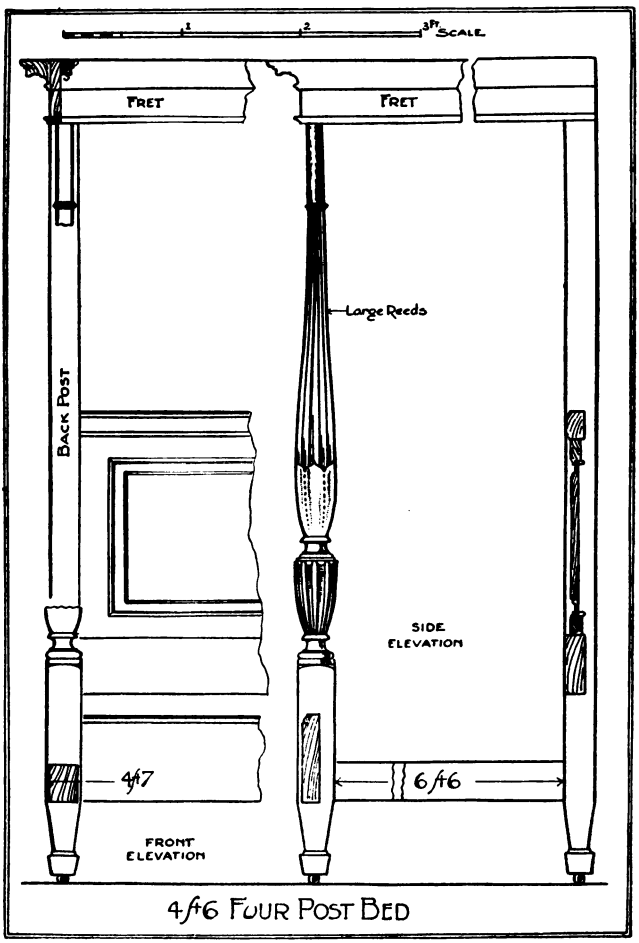

Details of the Four Poster Bed

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The fret applied to the cornice of the four-poster is built of three veneers glued together, with a grain of the center-piece running the opposite way to that of the two outside pieces. If not built up in this way, it is very brittle and liable to break before it is fixed in position.

The French bed, page 165, is a type much in favor now, and its construction needs little explanation; the caning should be done on both sides, and care taken that the pattern is exactly the same on either side.

A thickening piece is used on the head posts to strengthen them, and sometimes the same thing is done to

Perspective View of an Italian Bedstead

the foot board when the posts are not square. The arms of the Italian bed are made to wing and are sometimes hung with ordinary hinges; the type of hinge illustrated, page 169, enables the arms to be lifted off altogether if desired. The construction of this bed is similar to that of the other examples illustrated.

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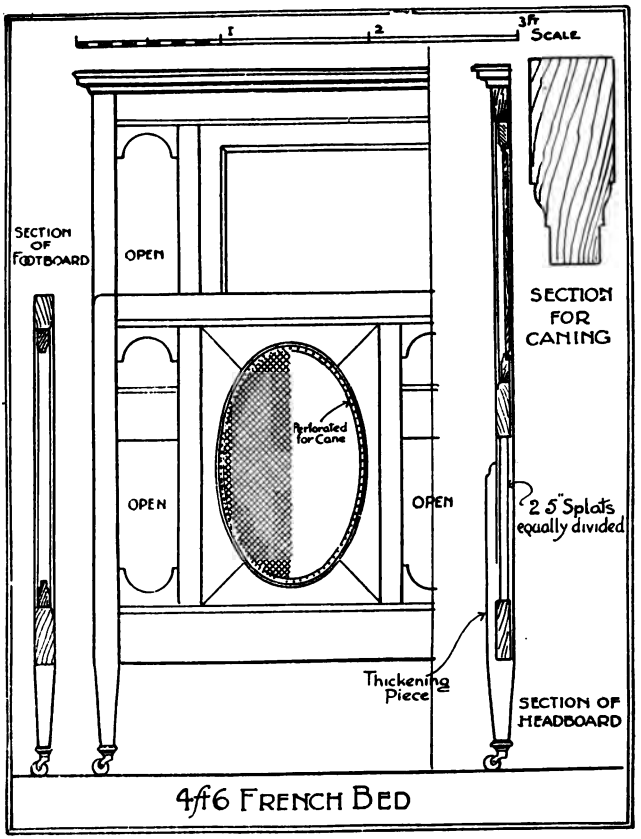

Details of the French Bed

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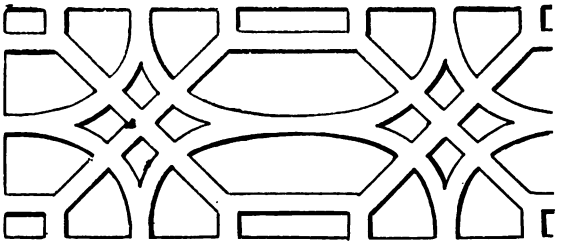
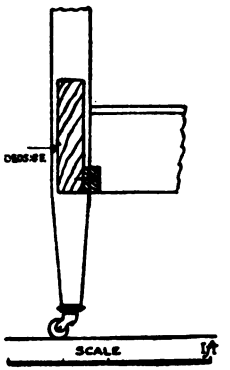
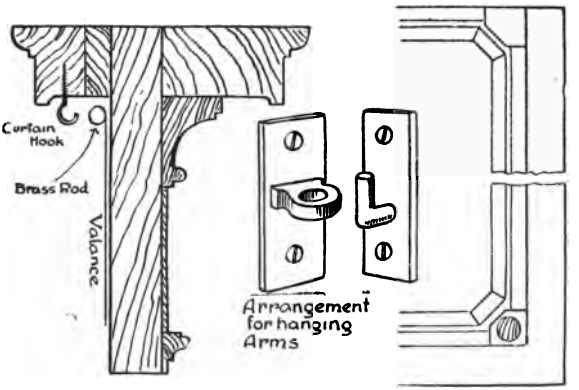


Detail of Fret on Four Poster Bedstead



Section Showing Bed Rail Arranged to Take a Box Mattress



Cornice Section Plan of Cornice

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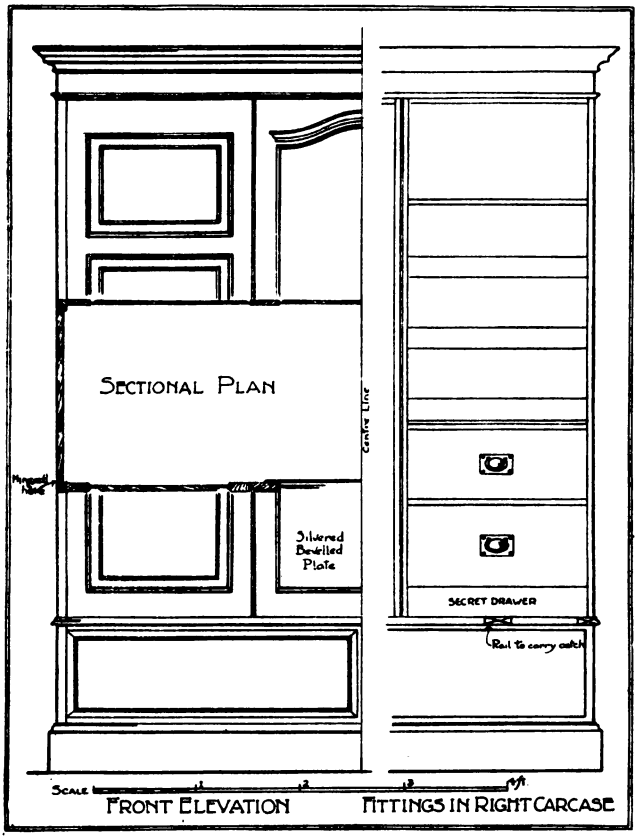

Some of the Details in the Construction of a Wardrobe

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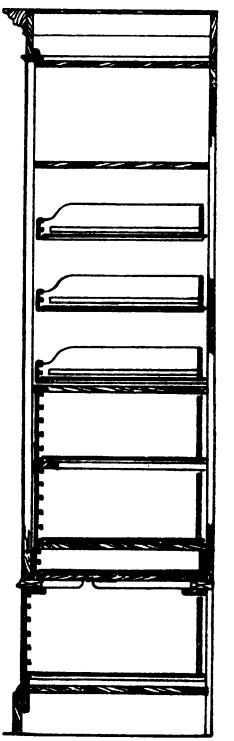
THE CONSTRUCTION OF A WARDROBE

WITH SECRET DRAWER

Although the wardrobe illustrated is of an every-day character as regards outline, it has unusual features in its construction which make it well worthy of study. The middle door is hung with center hinges and the method of finding the swinging center is shown at B, page 173. The principle is that the center or pivot can be placed anywhere on a line forming an angle of 45 degrees (which is a true mitre) from the opening edge, but it is advisable to place it as near the front as is consistent with strength because the nearer the front it is, the less the door throws in when opened. The wing doors are hinged on the ends and so swing clear of the carcase, allowing the drawers, etc., to slide past the edge of the door. If hinged to the pilaster, a false end must be used to enable the drawers and trays to clear the edge of door on being pulled out. A link plate lock must be used for the right door as there is nothing but the center door to bolt into; the locking plate is fixed into the carcase end. A wardrobe such as this is made in four parts for convenience of handling and contruction, and sometimes a loose plinth is used as well as a loose cornice. The trays are supported on quarter-inch hardwood slips which are screwed to the carcase ends and the outer sides of the trays are grooved to take these slips. At the bottom, inside the right carcase is a secret drawer, the front of which appears as a plain rail. It is opened by pulling out the bottom drawer and pushing up a lever which is held in position by a spring. Immediately the catch is released, a steel spring at the back forces out the drawer. In order to close it, it



END SECTION
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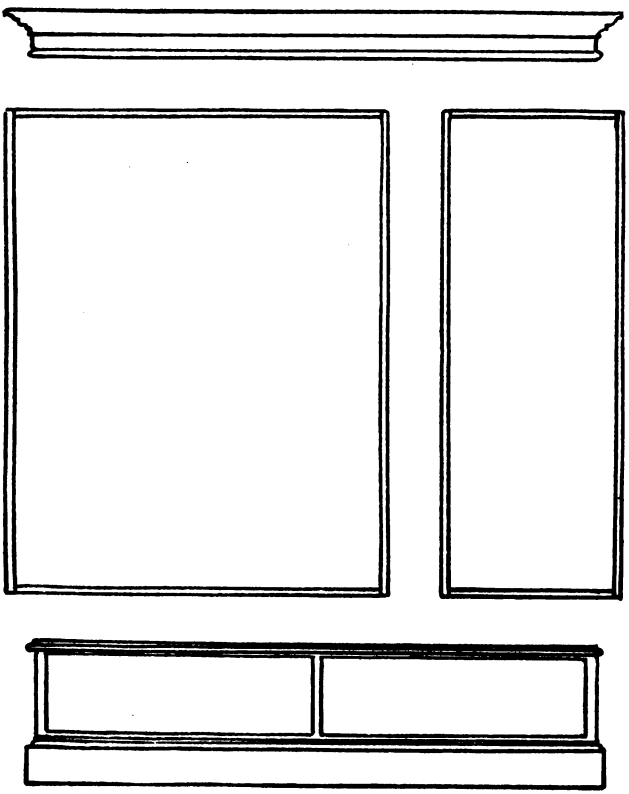
is only necessary to simply push it back and when the piece screwed to the underside of the drawer bottom has passed over the spring catch the latter shoots upwards and holds it firm. A drawer of this kind is useful for secreting jewelry, as thieves or pilferers are not likely to suspect a secret drawer in such a position. It can be used in a similar manner in any suitable article of furniture.



Sketch Showing Dividing of Carcase

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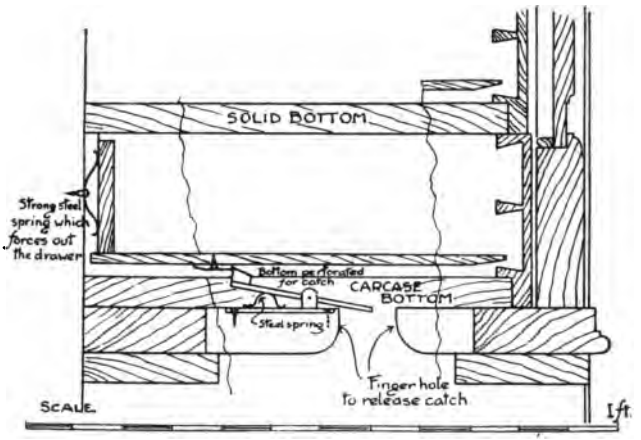
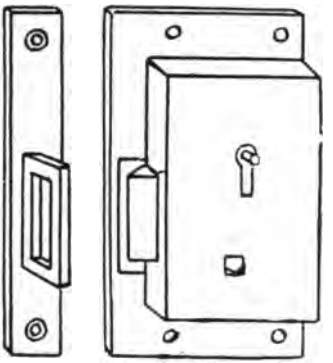
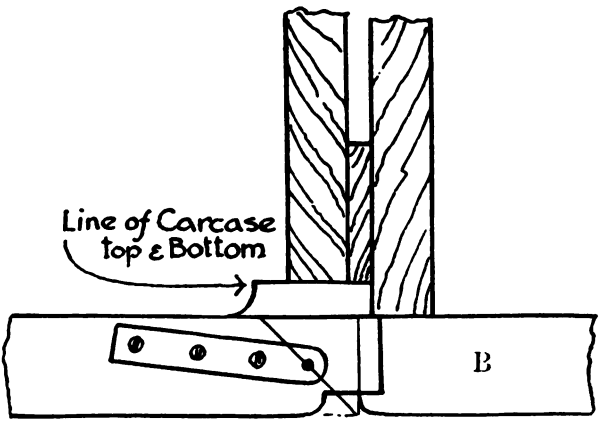


End Section Showing Arrangement of Secret Drawer



Link Plate Lock



Method of Fixing Center Hinge

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Perspective View of Movable Cheval Glass

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A SEMI-CHEVAL DRESSER

WITH SWINGING MIRROR

The problem which confronts the cabinet maker is making a toilet table is to bring the mirror as near as possible to the user, and at the same time to leave the table-top undisturbed for brushes, cosmetics and other toilet requisites. Several methods have been adopted, one of which is to make the whole top to slide forward with the uprights which support the mirror, but this is not entirely satisfactory, as if pulled forward with a jerk, bottles, vases or candlesticks may be overturned and cause damage. Another arrangement is to place small mirrors in the top drawers of the table, a device being employed to prop them in a vertical position when the drawers are open, but this, although satisfactory, as far as bringing the mirrors quite near a woman who is doing her hair, or a man who is shaving, does away with a certain amount of drawer accommodation.

The difficulty is still further increased with a cheval table on account of its greater depth and the enlarged size and greater weight of the mirror itself. Our illustrations show the ordinary type of cheval table. The only point which needs explanation is the method of moving the glass. This is effected by means of a swinging or moving support. This support is held at the bottom by a center hinge, one part of which is screwed to the inside support itself (see A), the counterpart or matrix being fixed to the jewel box. The top of the pin is riveted into its socket to avoid its being pulled out of position. This support, fixed thus, is free to make the revolution of a complete circle. Its "play" is kept within the necessary bounds by means of a piece of brass, segment of a circle (see B), which is let in flush with the end of the jewel box and screwed against it. It has a slot to take the iron pin which is fixed to the upper part of the wooden support and which has a small nut tapped on the top which rides against the inside of the segmental brass plate. It will, of course, be necessary to groove the end of the jewel box slightly to allow free pas-

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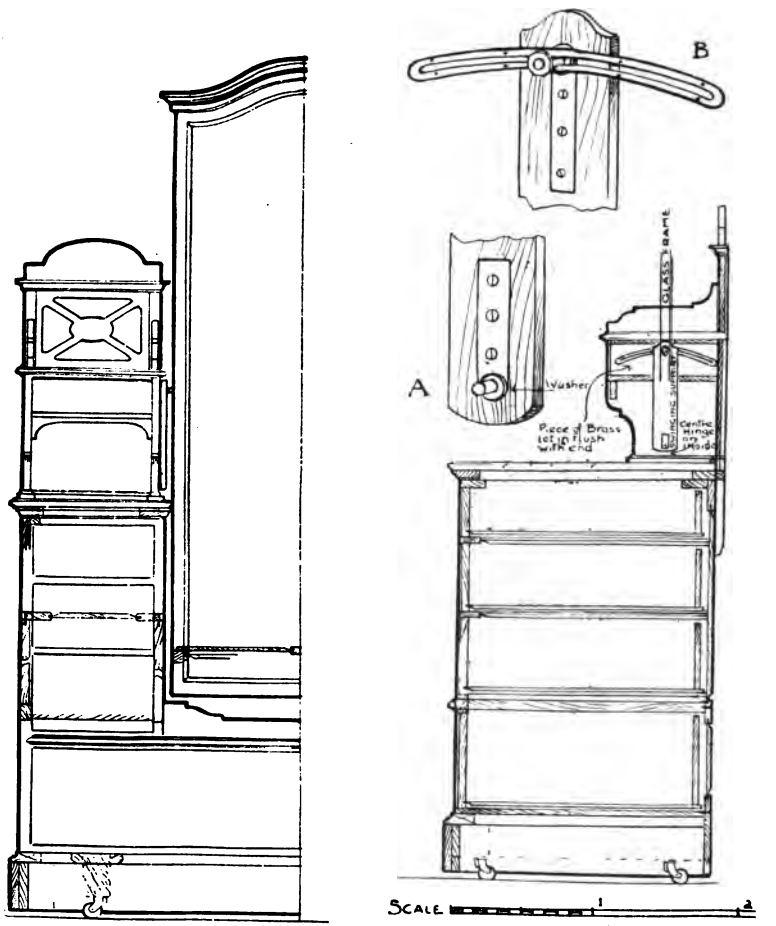
sage for this nut. The washers are employed to keep the side of the jewel box from being scratched by the support.

The glass is fixed to the moving support by the ordinary glass movement and can be adjusted to any angle in the usual manner. It may be mentioned in passing that the glass movement should be screwed to the mirror frame on the horizontal line passing through its center of gravity.



Some of the Details of a Semi-Cheval Dresser With a Swinging Mirror

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THE USE OF ORDERS.

DESIGNS COMMON TO ARCHITECTURE AND FURNITURE.

In dealing with the classic Orders of architecture, as far as cabinet work and joinery are concerned, we shall only need to study three—the Doric, Ionic and Corinthian. If the cabinet maker is conversant with the dimensions of these, he will be able to set out any classic Order from a rough sketch, the only dimension which he will need being the total height of the column including the capital and base. There are, as our readers probably know, excellent books dealing with the setting out of the Orders in great detail, published for the use of architects, but these do not help the cabinet maker very much, for when the Orders are reproduced in wood to a small scale very much of the detail is eliminated. For instance, the entablature of the Corinthian Order, consisting of architrave, frieze and cornice, in a large building is often several feet deep and crowded with detail. This, of course, has to be very much simplified when it is reproduced in wood to a very much smaller scale, say, 3 or 4 inches deep.

SUPERPOSITION

In setting out the Orders it must be remembered that the Doric is stouter than the Ionic, and that the Corinthian is more slender and graceful than the other two. In some interior work—mantelpieces, for instance—we often meet with a design with columns below the shelf and columns above. In such cases the stouter Order should always be placed beneath the lighter one. If the Doric Order is used below, the Ionic or Corinthian should be employed above it, and it would be a distinct failing in design to support a Doric column by an Ionic, or an Ionic by a Corinthian column. In a composition three stories high the rule of superposition lays down that the first story should have Doric, the second Ionic, and the third Corinthian, reckoning from the ground upward. This rule only applies where one or more of the Orders is used in the same decorative composition, and where only one set of columns is employed,

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the designer can choose either one of the three according as his fancy or the limitations of the design dictate. Another point to remember in the use of the Orders is their essential stability. In many of Chippendale's Gothic bookcases, for instance, when the doors were opened, clustered column pillars swung out with the door from under the entablature. Such obvious absurdity should be studiously

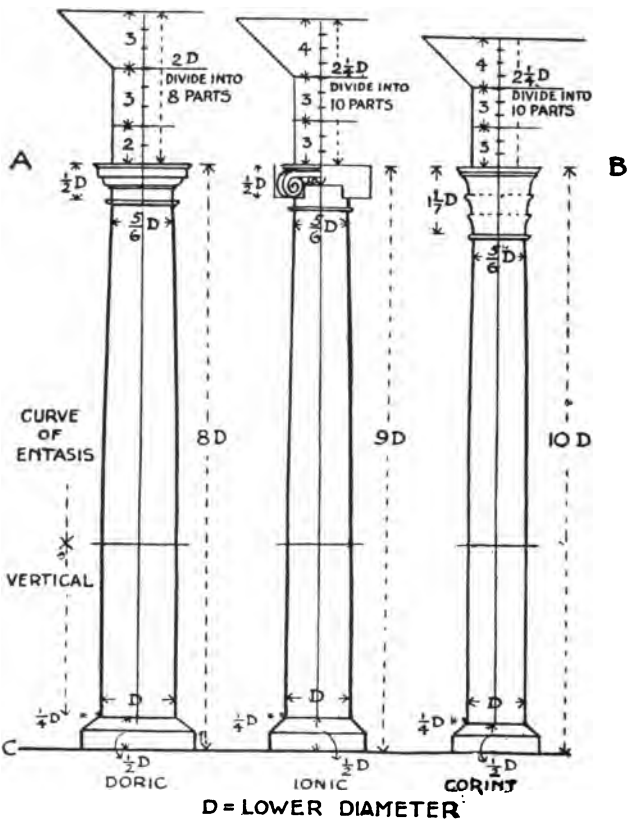

Plate I—Main Dimensions of the Orders as Used in Woodwork.

avoided. Another point to remember in architectural compositions is that projections go over projections. For instance, if one column is superimposed upon another, the center line of the one above should be identical with that of the one below.

ENTASIS

If a column is turned with its two sides exactly parallel, so as to form a perfect cylinder, it has the appearance of

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being smaller in the center than at the ends, and to do away with this optical illusion the Greek builders slightly swelled their columns and made them smaller at the top than at the bottom. This gentle curve of the column is called its entasis. In the small work which cabinet makers handle, it is hardly necessary to go into the elaborate calculation used by a builder for a large stone column, and the following simple rule will suffice: The column at its upper ex-

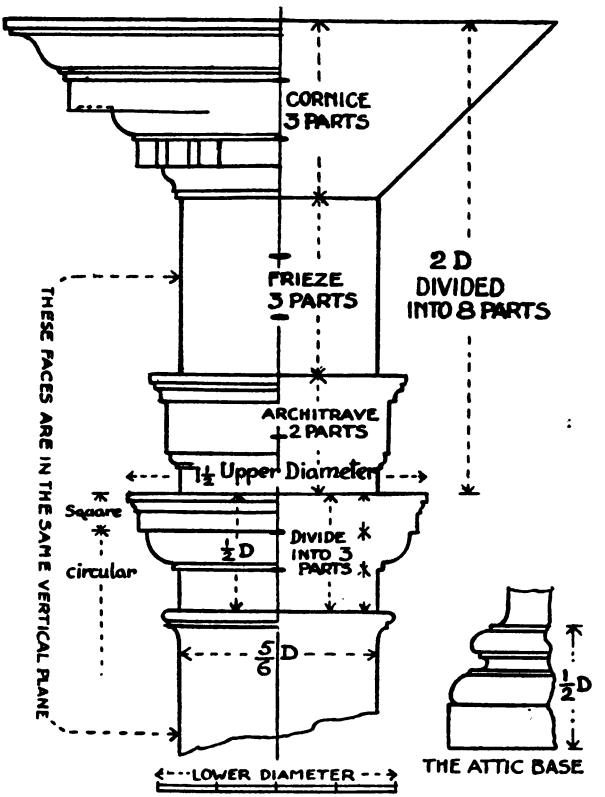

Plate II—Doric Cap and Entablature.

tremity measures 5-6ths of its lower diameter in each of the Orders—Doric, Ionic and Corinthian. To obtain the necessary curve, divide the height of the column into three parts, and in the lower third the sides of the column are exactly perpendicular. To obtain the gentle curve for the upper two-thirds a long lath of mahogany is generally used about 2 inches wide and 3/16ths of an inch thick. If this is grasped firmly at either end it may be slightly bent to the

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required line, and an assistant may use this as a guide for his pencil in drawing the curve.

THE DORIC ORDER

It is now proposed to describe in the simplest possible way how to set out the main dimensions of the Orders. It is only necessary to have one dimension fixed. The cabinet maker must know the height of the column, including the

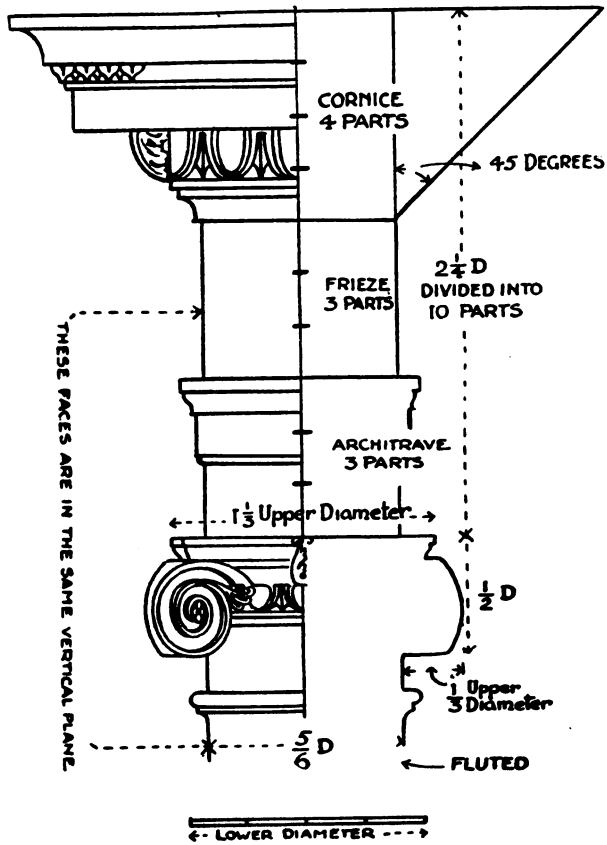

Plate III—Ionic Cap and Entablature.

capital and base. Let us suppose the height between the lines AB and CE (Plate I) is 3 ft. 4 in. = 40 in. Having settled on the height of the column, the next dimension to be obtained is the lower diameter. This is an easy matter, for in the Doric Order the column is eight diameters high, in the Ionic nine, and in the Corinthian ten. For the Doric Order, therefore, we have to divide the column (3 ft. 4 in.

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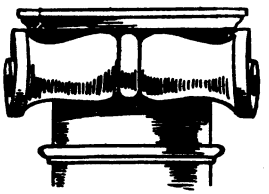
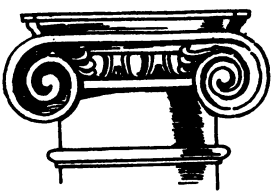
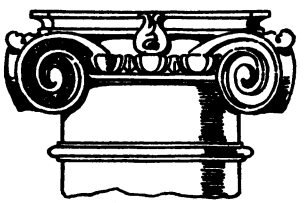
in height) into eight parts, one of which will give us the dimension of the lower diameter, which in this case is 5 in. The base is ½ D = 2½ in.; the projection of the base is ¼ D = 1¼ in.; the capital is ½ D = 2½ in. The upper diameter equals 5/6th D, and the entablature is 2 diameters, or 10 in. in height. This, in its turn, is divided into eight equal parts, two of which are allotted to the architrave, three to the frieze and three to the cornice. The projection of the cornice equals its height; that is to say, if a line of 45 degrees be drawn upwards and outwards from its lowest point, that would give the general outline of the moulding.

It is not usual to flute a Doric column. It should be noted that in each of the Orders the frieze is that part of





Ionic Capital, with Square Abacus.



Ionic Capital, with Curved Abacus.

PLAN OF ABACUS

Ionic Capital, Corner View.

the entablature to which decoration is applied; neither can too much stress be laid on the point that the line of the frieze is in all cases in the same plane with the line of the top of the column (see Plate 2).

THE IONIC ORDER.

The Ionic Order is worked out in a very similar way, but the column is rather slighter, owing to the fact that the Ionic is 9 diameters high instead of 8, as in the Doric. Again, take the height between AB and CE (Plate I) as 3 ft. 4 in. Divided by nine this is just about 4½ in.; 4½ in. is, therefore, the lower diameter—which is abbreviated in the diagram to "D"—or the unit of measurement. The

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base as before is ½ D, upper diameter 5/6ths D. The entablature 2¼ D is divided into ten parts as follows: Entablature 3, frieze 3, cornice 4. The Ionic column may be either plain or fluted.

An Ionic cap may be formed in two ways—either with a curved abacus and the volutes standing diagonally when viewed from the front, or the caps may take an oblong form.

The curved abacus is the most graceful form for woodwork, and the one generally employed by high-class cabinet makers and joiners. The curve of the abacus may be obtained in the same way as shown on Plate V in connection with the Corinthian Order.

THE CORINTHIAN ORDER.

We come, lastly, to the Corinthian Order, and the main dimensions for this are also given on Plate I. In this Order the column is 10 diameters high; the lower diameter therefore, measures exactly 4 in. The capital is 1+ 1-7 D high, 1-7th of which is taken up by the curved abacus, and the bell is divided into three equal parts (as shown on Plate IV). The Corinthian capital is decorated with sixteen leaves, eight in the first tier and eight in the second, arranged as shown, and a volute under each of the corners. The way to set out the curved line of the abacus is shown on Plate V. Draw CD and EF at right angles to one another; bisect the angles in the center by the lines GH and KL. From the center R measure off one diameter on each of the diagonals, and the points obtained will give the extremities of the abacus. Cut off the corners at KGL and H, being careful to allow sufficient width for the moulding, which diminishes towards the bottom. (See S). Then with center A and distance AB describe the arc BT, and with center B and distance BA describe the arc AT. Let these two arcs meet in T, and with center T and the same radius describe the arc AB. This gives one side of the abacus. Proceed to draw the curves on the other sides by the same method.

The small sketches in the top right-hand corner of Plate V, if studied, will serve to prevent a mistake which is frequently made in the cutting order by cabinet foremen. The draughtsman sometimes omits to give a plan of the capital and abacus, and the foreman measures up the stuff required for the carved capital from the front eleva-

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tion; but, as will readily be seen by measuring the drawing, the distance GB (see plan of abacus, Plate V) is considerably greater than the distance AB. The block of wood supplied for the capital is thus too small unless the diagonal dimension is taken into account.

THE BUILDING UP OF COLUMNS.

In joinery work the columns are sometimes of consid-

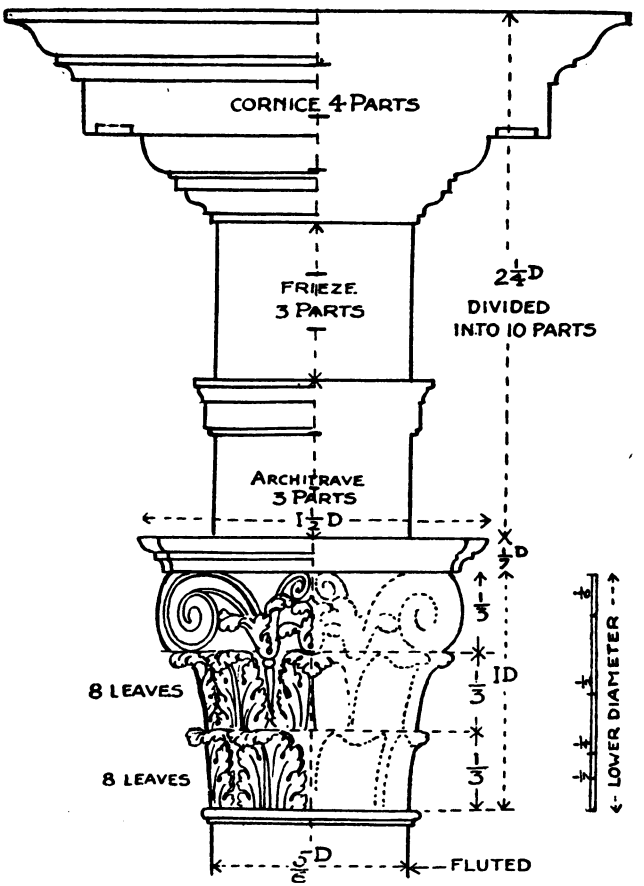

Plate IV—Corinthian Cap and Entablature.

erable size, in which case they are built up as indicated in the bottom left-hand corner of Plate V, in order to prevent any possibility of splitting. To save material, the base is turned separately, the joint being made at the point indicated. The column is fluted before the base is fitted on, and when this has been done the semi-circular finish is

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given by the carver. This method insures absolute accuracy. The necking mould just below the capital itself is turned on the shaft of the column. The base shown in Plate V is what is called the Attic base, and it is used indiscriminately both for the Doric, Ionic and Corinthian Orders in woodwork. It must be remembered that in some of the historic styles, notably in Jacobean and Elizabethan times,

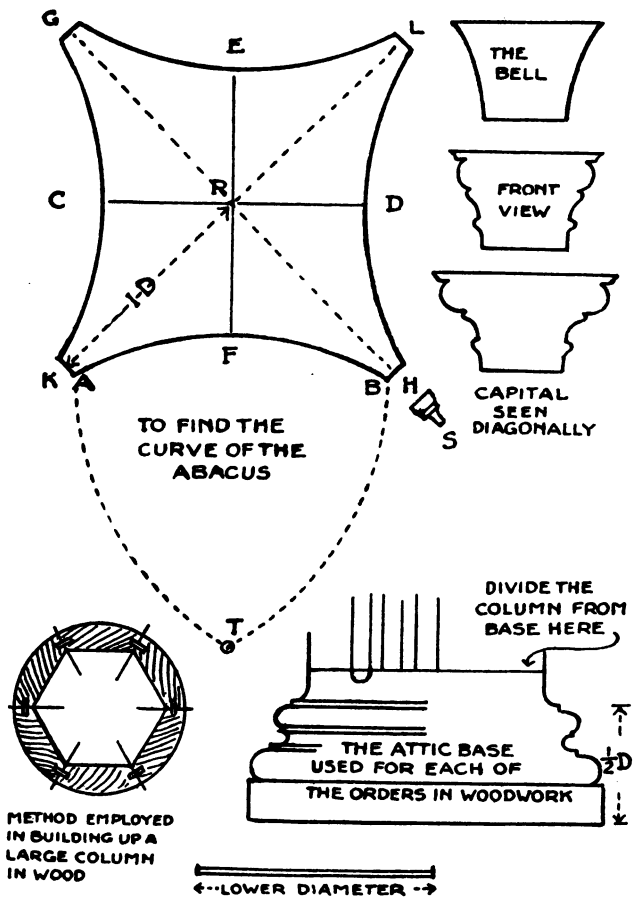

Plate V.

the Orders as used by the English workmen, before they thoroughly understood the Renaissance detail, were very crude. The width of the Ionic capital, for instance, was sometimes out of all proportion to its height. Squat columns were used, and the entablatures and other details lost all sense of proportion. It is this quaintness and lack

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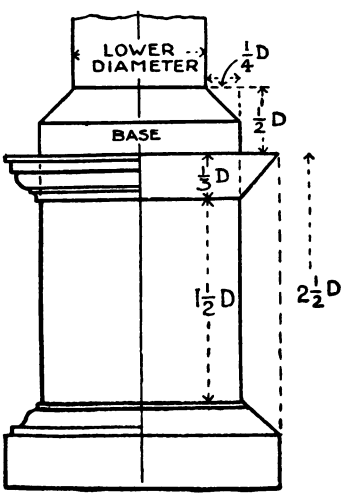
of nicety in proportion, coupled with a certain artistic sense, which lends to the early woodwork in this country its peculiar charm, and it is those variations which should, of course, be studied by the cabinet-maker who is reproducing the work for that period.

Then, again, there has been considerable variation in the carved details of the capitals at various periods in the Ionic and Corinthian Orders. For instance, some of the Georgian designers developed a florid style of capital which differed very much from the precise detail found in the Louis Seize work at the Petit Trianon. But these, after all, are questions of style, and the object of this chapter has been to set out as clearly as possible the main dimensions of the three Orders. All complicated measurements have been studiously avoided, and if the cabinet maker follows the simple rules enumerated above, he will escape the errors in proportion which are most frequently made.

In conclusion, the mouldings which are drawn in connection with the three Orders are merely suggestions and may, of course, be varied according to individual taste.

The classical column used in woodwork and joinery is generally placed upon a square pedestal which, like the different parts of the columns, should conform to certain definite proportions. The width of the pedestal itself is in all cases identical with that of the width of the base of the column. In the instructions for setting out the Orders the projection of the base has been given as a quarter of the lower diameter; but if this errs at all, the projection is rather too great than too little, and a fifth of the lower diameter may be taken if the designer so wishes. In this case, of course, the heights of the pedestals would remain about the same, but they would be contracted in width making them appear rather taller and narrower.



Corinthian

The Doric pedestal is 2½ D in height, and the width is equal to that of the base of

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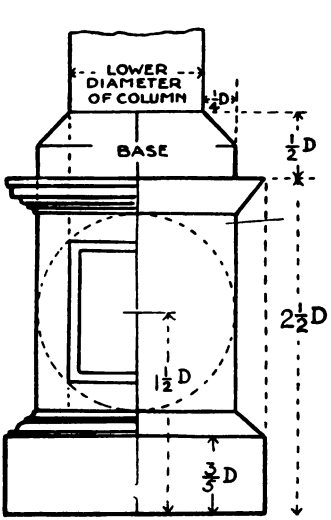
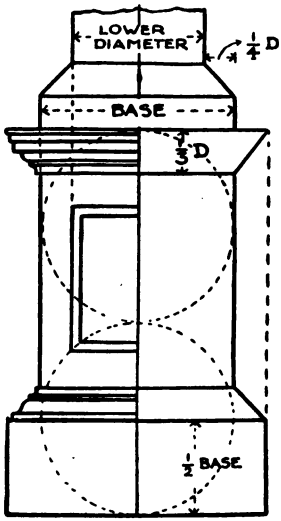
column. Mark off 1½ D from ground line on the center line and, with that point as center, construct a circle as shown. The highest and lowest points of this circle will give the lower line of the capping mould and the top line of the plinth moulding respectively.

In the Ionic pedestal, as before, the width of the pedestal equals the width of base of column, and the total height is twice the base, as denoted by the two circles.

In the Corinthian the pedestal is 2½ D in height. Measure ⅓ D from the top to give the bottom line of the capping mould, and 1½ D from this lower line will give the top line of the plinth moulding. It will be seen that the



Doric



Ionic

proportions are exceedingly simple, and that scarcely any explanation apart from the diagram is necessary.

If it is desirable to make the pedestals taller and narrower, make the projection of the base from the column 1/5 D, instead of ¼ D as shown here.

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SIMPLE TABLE FOR FINDING THE MAIN DIMENSIONS OF THE CLASSIC ORDERS OF ARCHITECTURE

	Doric		Ionic		Corinthian	
	GREEK Theseus	ROMAN Vignola	GREEK Vesta Eleusis	ROMAN Vignola	GREEK Lysicrates	ROMAN Pantheon
Height of Column	5 1/7	8	9	9	10	9¾-10
Flutes	20	24	24 *fillets*	24 *fillets*	24 *fillets*	—
Upper Diameter	3/4	5/6	6/7	5/6	5/6	5/6
Height of Base	—	1/2	1/2 Upper Diameter	1/2	1/2 Upper Diameter	1/2
Projection of Base	—	1/4 Upper Diameter	1/5	1/5	1/4	1/5
Abacus Width	1½ Upper Diameter	1 1/2 Upper Diameter	1 1/6 Upper Diameter	1 1/3 Upper Diameter	1 1/2 and 1 1/7	1 1/2 and 1 1/6
Capital Height	+ Hypotenuse 1/2	Top of necking } 1/2	Volute of Abacus } 3/4 Upper Diameter	Volute of Abacus } 3/5 Upper Diameter	1 1/2	1 1/4
			Width across Volutes } 1 5/12	Width across Volutes } 1 5/12	Width across Volutes } 1 5/12	Width across Volutes } 1 1/5

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Entablature		2 1/6		2		2		2 1/4		2 1/3 Then 4/3 for Architrave		2 1/4 full	
Subdivisions Entablature		Divide into 8 parts	3 parts	Divide into 8 parts	2 parts	Divide into 15 parts	4 parts	Divide into 10 parts	3 parts	Divide into 11 parts	4 parts	Divide into 10 parts	3 parts
(Architrave		3½ . .	3	4 . .	3 . .	3 . .	4 . .	3 . .	4 . .	3 . .	4 . .	3 . .	4 . .
Frieze		1½ . .	3 . .	5 . .	4 . .								
Cornice)													
Projection of Cornice		1/3 height		1½ height		¾ height		Equals height		Equals height		Equals height	

NOTE. UNLESS OTHERWISE MENTIONED, THE LOWER DIAMETER OF COLUMN IS THE STANDARD MEASUREMENT

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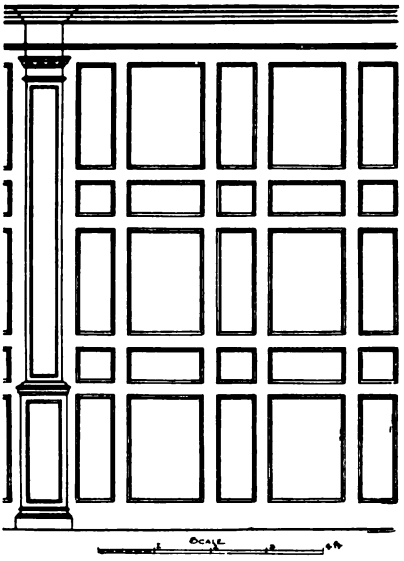

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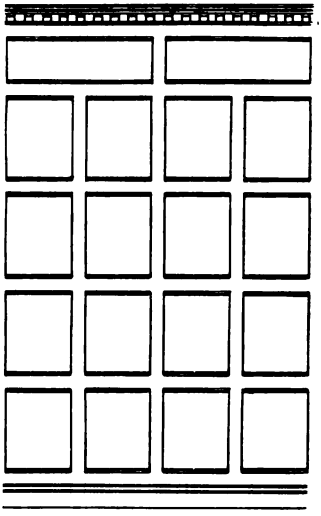

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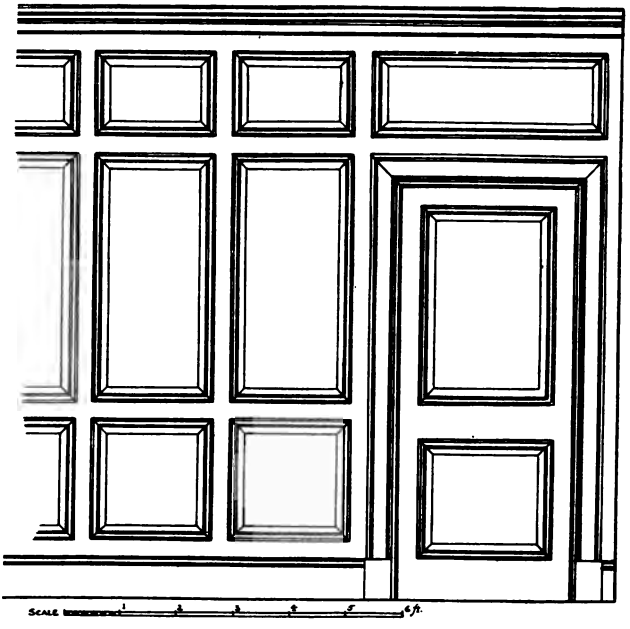

No. 3.

The Construction of Panelling.

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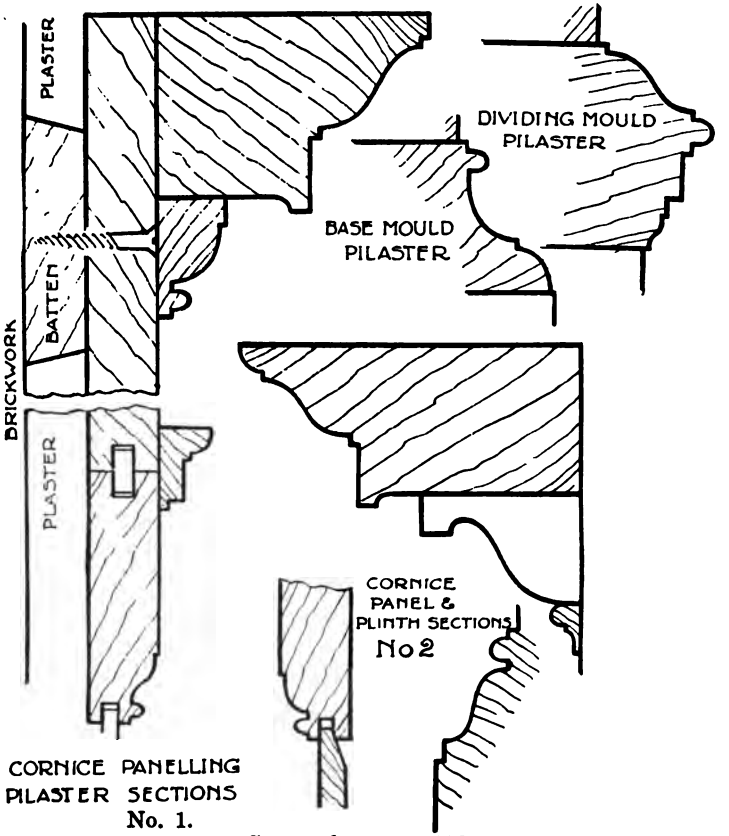
PANELLING.

ITS CONSTRUCTION AND FIXING.

In the early years of the 16th century panelling became a somewhat common form of covering for the interior walls of the best houses, and even today we have nothing better or more artistic as a background. The edges of the



See scale, page 192

Some of the Details of No. 1 and No. 2.

framing were almost always moulded; at first the mould was formed on the framing, but later, separate mouldings were mitred and applied round the panels. No. 1 scheme shows the panels with a moulding on three sides, finishing

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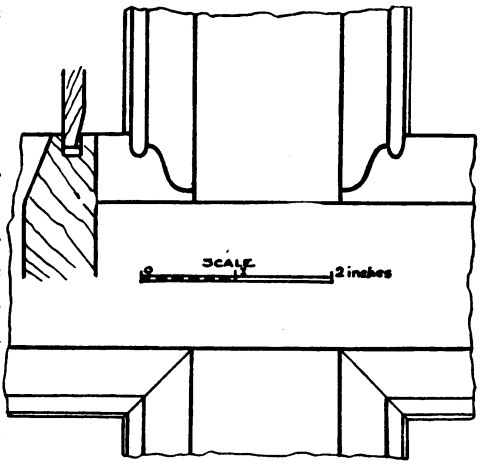
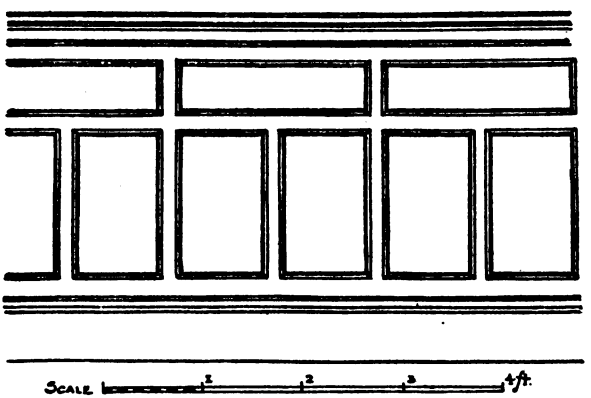
on a bevel at the bottom for convenience in dusting. This bevel is a survival of the weathering on exterior work of the Gothic period. As regards thickness, the panels should be hand-tight in the grooves, which should be made deep enough to allow the panels to swell. To break the monotony of the design, pilasters are often introduced to emphasize important features of the room, such as windows and doors. The old panelling was usually carried down to the floor without a plinth or skirting. In first-class work, when a skirting is used, it is provided with a tongue at the bottom edge, which fits into a groove cut in the floor, thus if shrinkage takes place, there is no open joint. If it is possible, it is best to have prepared grounds for fixing the panelling to the walls. These consist of a series of battens fixed to the wall before plastering, in a favorable position for the screws. The battens are generally 3 in. by ¾ in., and have bevelled edges, as shown in the illustration. In cases where the walls are not prepared as described, plugs are used, and the panelling is



Panelling, Section No. 1



Example No. 4.

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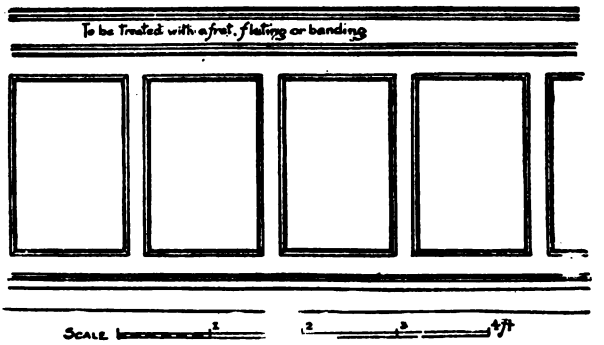
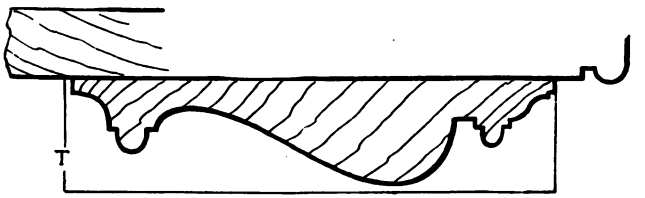
screwed to these, and thus secured to the walls. Often a room has to be measured for fitments and panelling when

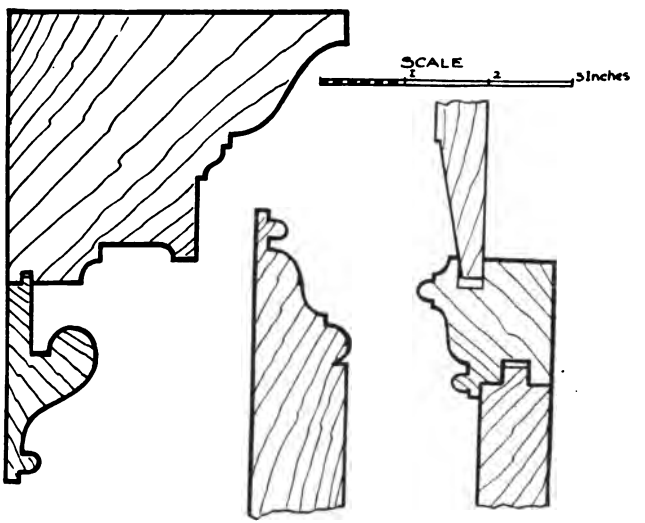


Example No. 5.

the building is still in the brickwork stage; 1½ in. should be taken off each measurement to allow for this, as the



Section Through Panelling, etc.



Some of the Details of No. 3.

plaster on each wall will be ¾ in. thick when the work is finished.

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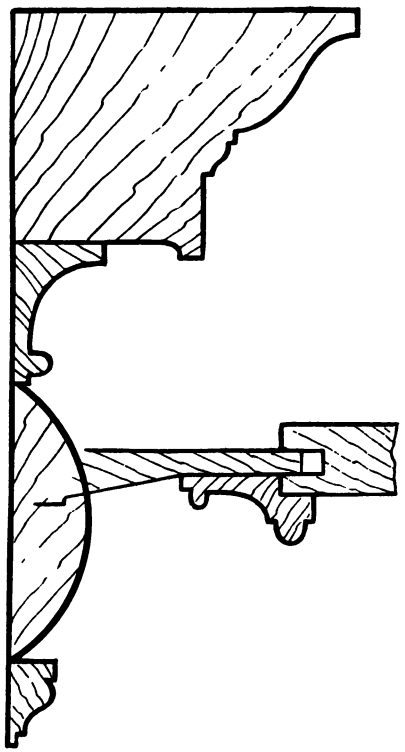
Small panels are characteristic of nearly all panelling down to about the middle of the 17th century, after which the panels were much larger and surmounted by heavier mouldings. The great width of the panels in the panelling made during the second half of the 17th century, and its splendid condition today, as regards freedom from shakes and warping, is remarkable to the workman cognizant of the varying conditions found in much of the wood now used. The details and general dimensions as shown on Scheme 3 would harmonize with the furniture of the latter part of the 17th century. It will be noted that a picture moulding forms the bottom of one of the cornice sections; this is an unusual feature in old work, but a very useful one in modern times. The cornices of the period under consideration were generally elaborately carved, and often a moulded chair rail was fixed between the lowest and upper panels. In the alternative section the panels are raised above the framing; this plan was often followed. Perhaps the most fitting form of wall decoration for an 18th century interior is a dado of panelling, the walls being covered with paper or damask, surmounted by a modelled plaster frieze and cornice. The dado is generally painted white, but where hard woods are used it is, of course, possible to carry out the decoration in harmony with, rather than in contrast to, the furniture. For instance, the introduction of a fret in the frieze of a dado for a Chippendale drawing-room, fluting and paterae for a room in Adam style, and bandings and inlaid lines for Heppelwhite and Sheraton. Taking the



Section of Panelling

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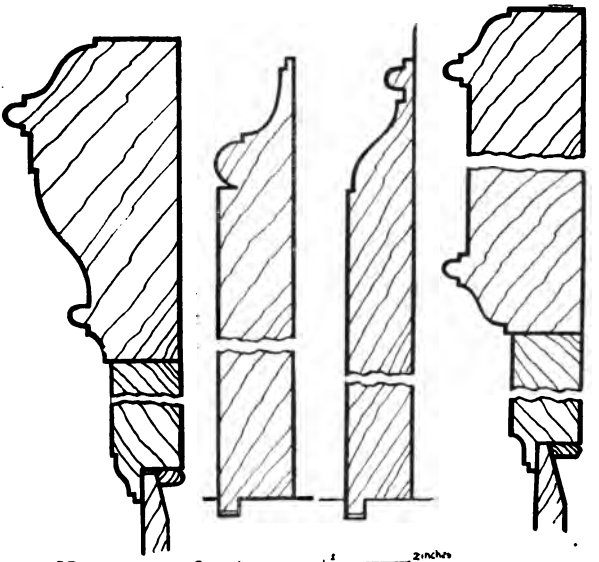
walls as a background for furniture, a white dado is very much to be preferred from a decorative point of view. In much of the best-class work mahogany, finished white, is the



Section of Moulding

material used. Unfortunately it frequently happens that panelling has to be fixed in position before the building is quite dry; as a precaution against the expansion of the woodwork from dampness, the back of the panelling is treated with lead paint.

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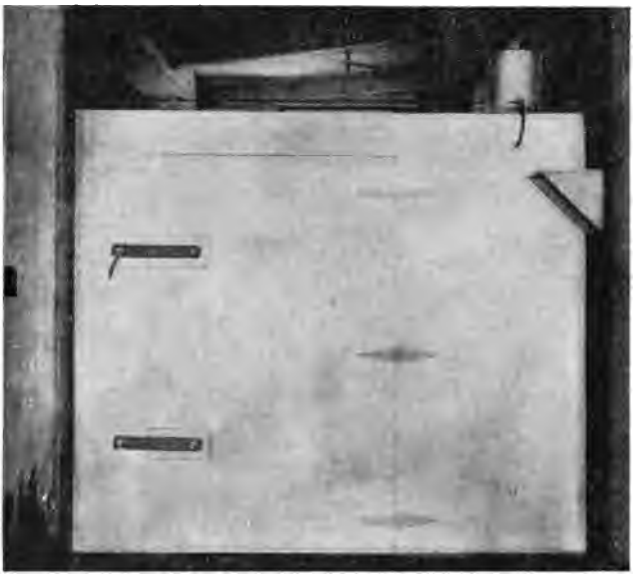
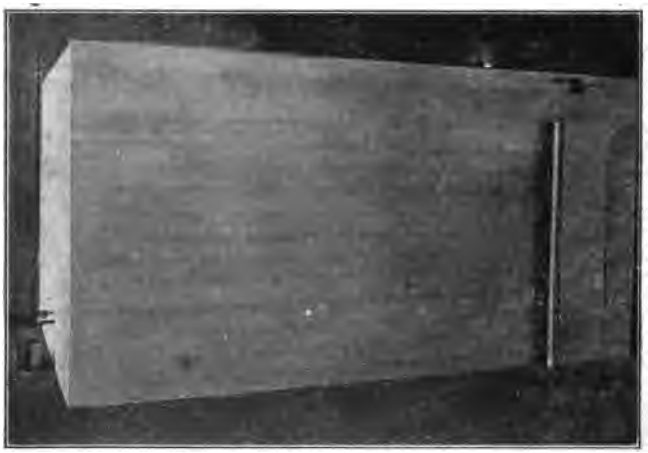


The Front.



The Side.

Two Views of Fuming-room Built After Plans Described in Following Chapter.

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THE CONSTRUCTION OF A FUMING-ROOM

By Walter K. Schmidt.

With fumed oak as much in vogue as it is at the present time, it is almost necessary that something in the way of a fuming-room or fuming box be supplied. I shall endeavor to describe two types of this sort of equipment, supplementing it with some description of the process.

The size of a fuming box, or fuming-room, must be left with the manufacturer and be built according to his needs. After the size of the box has been determined upon, the following methods, if followed, will produce a strictly up-to-date fuming box:

Select a place in the factory which is easily accessible to daylight, blow-pipes and steam. After setting up the frame work of the size which has been decided upon for the box, inclose it with matched flooring, giving each groove or tongue a coat of thick paint and driving the joints well together. On the sides, make the sash for the glass as indicated in Fig. 1. Be careful that the glass, when put into the sash, is either set in soft putty or lead in oil. The reason for this is to make everything air-tight. The door should be a sectional one so that it can be opened for the various sizes of furniture, as it is often the case that after a first batch has been fumed, another batch of furniture can be quickly put in this box without exhausting the ammonia gas. The doors should be made with L joints and these joints fitted with felt. The doors are then locked with a friction lock much like those that are used on an ice box. In a corner, convenient and accessible, a series of shelves should be provided, the upper one a distance from the ceiling so that it will carry a five-gallon galvanized iron can. This can should be fitted with a faucet. The successive shelves should be supplied with

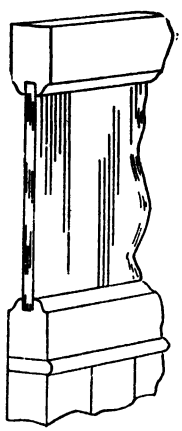

Fig. 1.

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Two Views of the Interior of the Fuming-room Built After the Plan Described in This Chapter.

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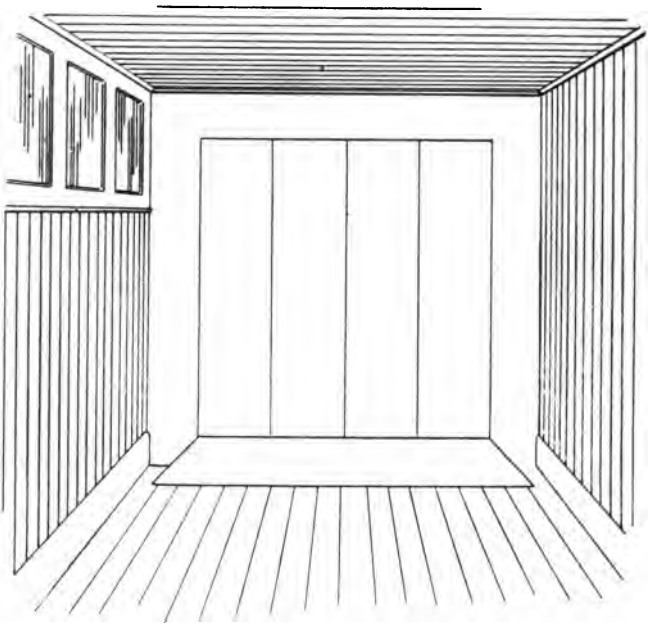
half inch deep pans, placed in such a position that when the first is filled with ammonia water it will overflow into the second and so on down until the last pan empties into usually a five or ten-gallon earthen jar.

A steam coil placed in the jar will greatly facilitate the evaporation of the ammonia or, rather more correctly stated, of liberating the ammonia from the water and work an economy by reducing the amount of ammonia required. Right here is where caution must be exercised. First, the



No. 2. Interior View of Fuming Box.

steam coil must be placed in a jar which is at least twice as large as the can. The steam coil takes up less than half of the space in the jar. This coil must then be covered with water and the steam should not be turned on until the ammonia water begins to drip from the last pan into the jar, for if the coil is not covered with water, the drippings will come down in such small quantities that they will immediately be evaporated and cause excessive moisture in the fuming box. Again, the steam must not be supplied to the coil in too great a quantity and thus create too much heat. It must be kept under control and the water maintained just below the boiling point. This can all be done by

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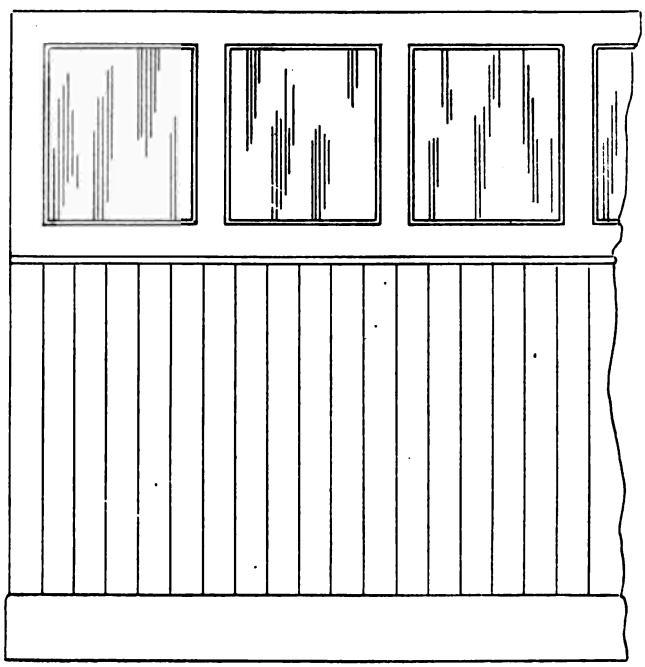
watching the process through the window. The question has often been asked whether the ammonia can be turned on before the doors are closed. This, of course, is the only way it can be turned on. But it might be well to turn on the ammonia and allow the gas, in a measure, to replace the air before the doors are closed tightly.

For those who do not wish to supply their fuming chamber with windows, the arrangement of an opening, called the testing box, is recommended. A sliding door of a size varying according to one's idea, say 10 by 12 to 10 by



No. 3. Showing Arrangement of Windows.

20 inches, is made and back of it a box is placed which again is fitted with a sliding door. When the fuming chamber is charged with gas, the inner door is opened, and the outer one closed. This outer door can be made of glass so that the process can be watched. When you desire to examine the results, close the inner door, take out the piece and test it by giving it a bit of oil, rubbing it off and shellacing it. If the desired depth is not yet produced, replace.

The entire interior of this chamber should be painted with the same care that you would paint a boat, and all

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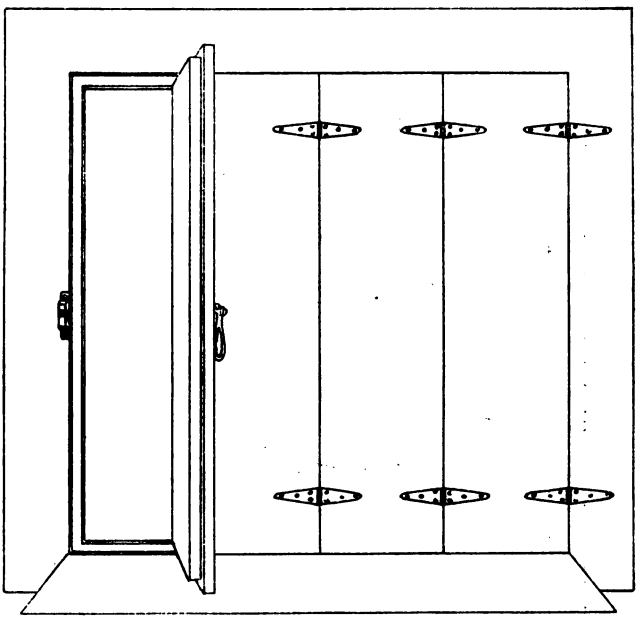
crevices closed. In mentioning the size, it should be stated that it is not wise to build it any higher than required for the tallest piece of furniture. It costs money to fill the surplus space with gas. On the sides of the chamber, provide fastenings so that the pieces can be piled up to the ceiling without resting upon each other, much as the bed slats were arranged in an old-fashioned bed. In this way all the available space can be used. A box constructed in accordance with these directions will bring out results in the shortest



No. 4. The Sectional Doors.

possible space of time. These can, however, be greatly augmented and the time reduced, when it is necessary, by coating the work with tanned bark extract, about one part to ten of water. The result, or rather color of the wood, can be varied by varying the strength of the application of this tanned bark extract. It is possible to turn out a thoroughly fumed batch in six hours by use of this extract. The question, of course, then is, which is the cheaper: to run the fuming box two or three times as long, or to coat the wood with an extract solution? It is a fact that a much deeper effect or color can be made when the extract has been applied.

Various ways have been tried for the obtaining of

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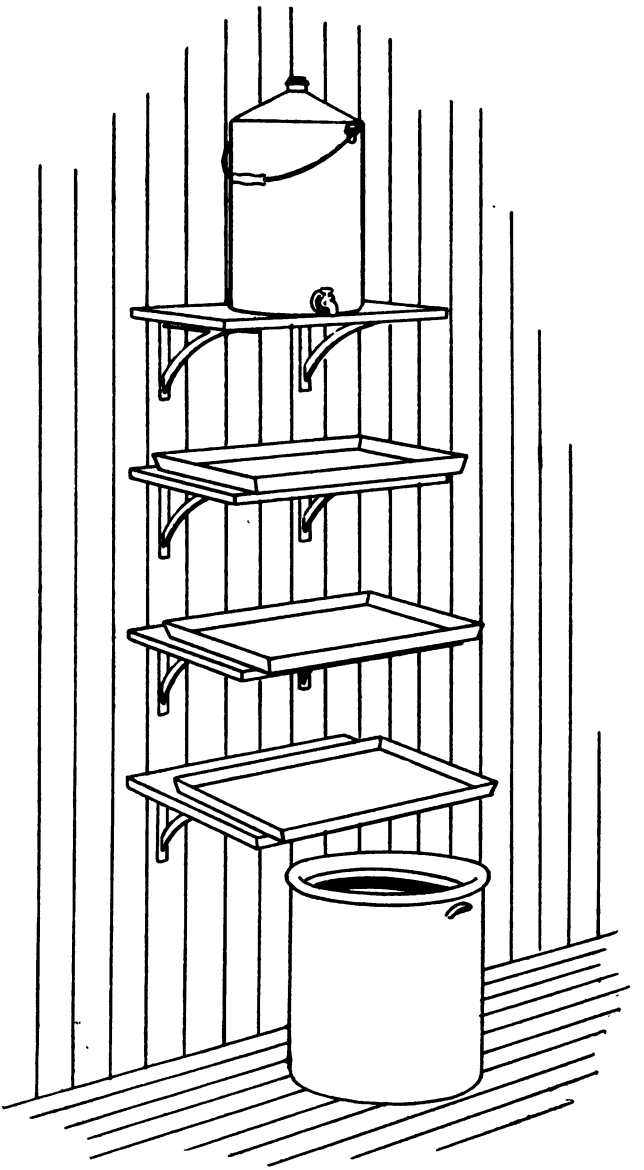

No. 6. Arrangement of Ammonia Tank.

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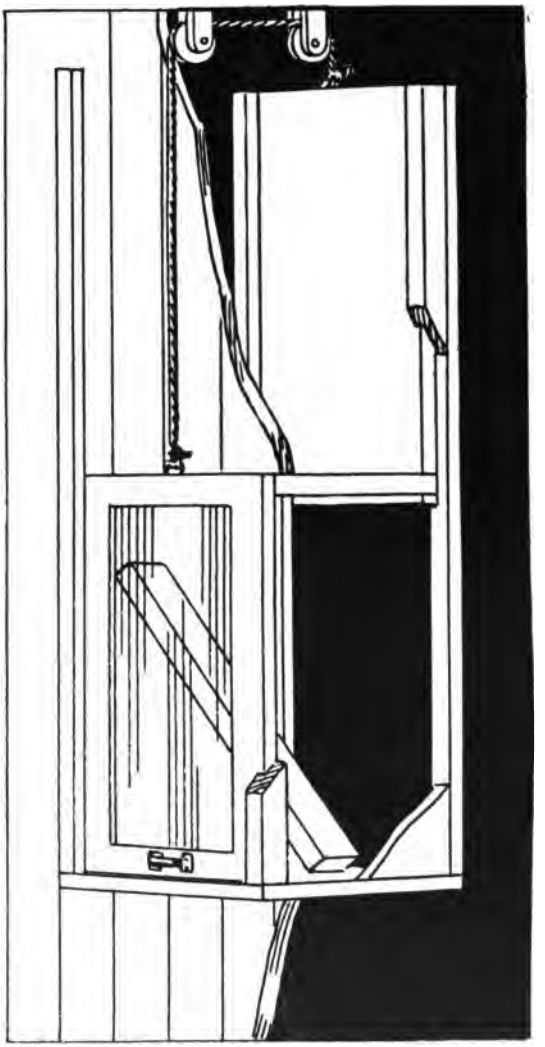

No. 8. Showing Sliding Door for Testing.

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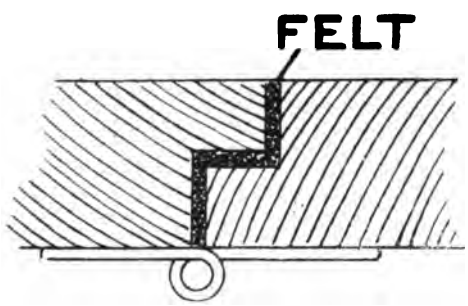
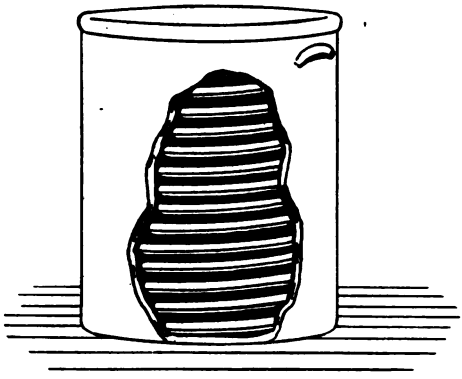
ammonia fumes, such as the baking of carbonate of ammonia (which is a crystalline salt); by placing it on tin pans under Bunsen burners; by mixing carbonate of ammonia with unslacked lime and then moistening with water, etc.; by using the anhydrous ammonia and, lastly, by employing aqua ammonia or water of ammonia. Anhydrous ammonia is the gas which has been liquified by compression and will expand into gas again as soon as the pressure is released. A cylinder of 100 pounds contains 100 per cent. of absolute ammonia and requires more careful attention than aqua ammonia, which is a distilled water which has absorbed a large volume of ammonia gas by its own affinity and not under pressure. The ammonia in the aqua ammonia can easily be driven off by heat until nothing but the pure water remains, and this can be done by the steam coil arrangement and the agitation afforded by the dripping from pan to pan.



No. 5. Showing Joints Filled With Felt.



No. 7. Jar Filled With Coils.

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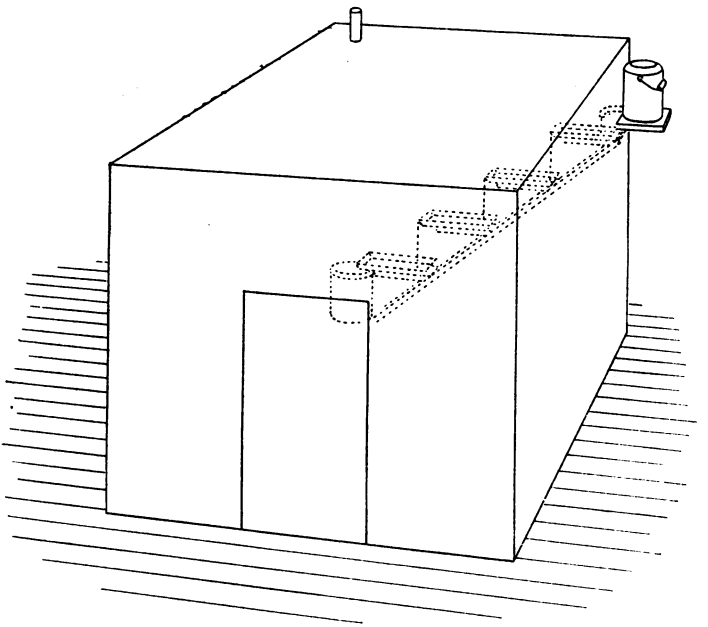
A SIMPLER TYPE OF FUMING BOX

BUILT OF CANVAS

But it may not be possible in every case to construct as elaborate a fuming-room as has already been described. It certainly is not at all probable such an equipment can be introduced in the manual training schools. But here is a simple form of canvas fuming box which will do its work.

Out of 2 x 2 material set up a frame-work, according to the size of the box desired, and cover with unbleached



Perspective View of a Canvas Fuming Box.

cotton, the weight of this to be determined by the size of the box. When the four walls are set up and screwed together, put between the joints pieces of felt or some heavy material previously saturated with silicate of soda (liquid glass) which can be purchased at about 40 to 50 cents per gallon. When the screws or bolts are drawn tight, air-tight joints will be secured. The top is put on in the same

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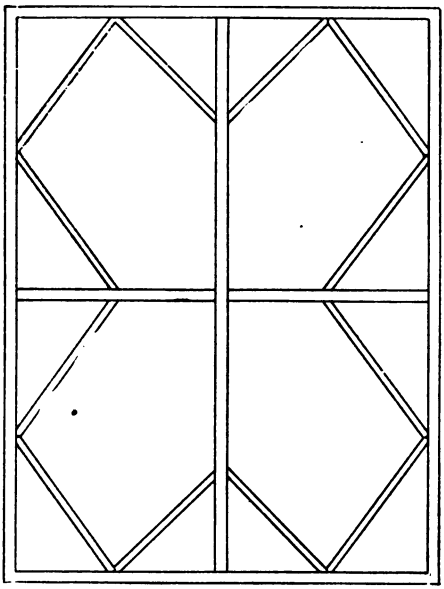
manner. The door can be covered in the same manner. When the frame-work is bolted or screwed to the floor, which oftentimes is uneven, use a half-round, under which is placed cloth saturated with the liquid glass and drawn down with screws. Then, after the box is set up entirely, give it a coat of liquid glass and two coats of paint. This will give an absolutely air-tight fuming box, inexpensive, but serviceable.

The arrangement of the can may be made as for the larger fuming-room, or it may be placed outside with a tube running through the wall of the box into the first pan. The capacity of these pans, together with the final re-



Showing Arrangement of Frame-work.

ceptacle, should be a little greater than the supply can. After the box is loaded, the ammonia is turned on and led into the pan by means of a small tube. It can remain in this manner until the process is complete. The fumes can be exhausted by connecting the top of the box with a blower. The exhausting of the box will be accomplished quicker by opening the door an inch or two so that the same amount of air is let in as exhausted by the blower.

While the process here described contemplates the evaporation of ammonia without artificial aid, the process is objectionable. First, it is slow. Second, it is rather un-

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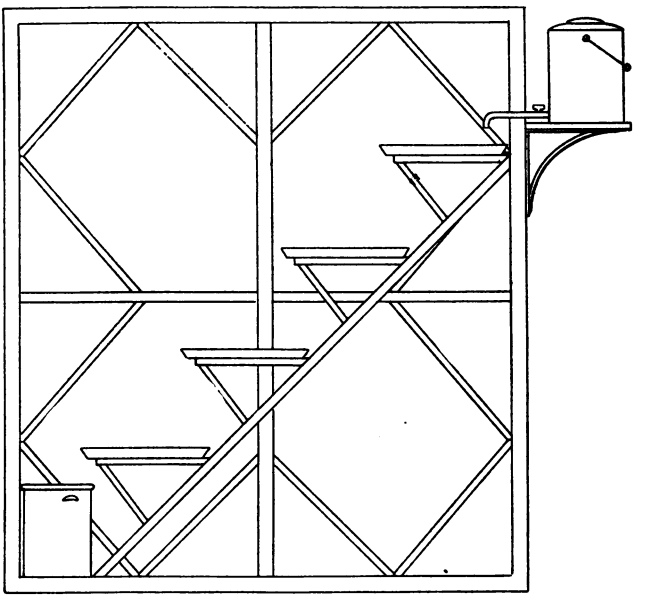
certain in its results, because of the liability of the ammonia to vary in strength. Third, because in purchasing and transporting ammonia in the liquid form, it is necessary to transport a large amount of water. An inventor, whose device is shown with this, has sought to overcome all of these objections. The system depends upon liquefying the gas and accurately measuring it and then permitting it to enter the fuming box in a gaseous form only. In this patented system, the anhydrous ammonia is used, and it is claimed that the operator is placed in position to know absolutely just how much gas per cubic foot of space to use



End View Showing Arrangement of Ammonia Tank and Tray.

in order to produce a certain shade of color. It then becomes a matter of simple equation, thus: space + gas = time + results. The operator will then work out his definite formula and control his shades by the amount of gas and time—space having become a known quantity. To do this, the apparatus shown in the illustration is used. One pound of anhydrous gas is used for every 200 cubic feet of space in the fuming box. The apparatus works automatically. There is no danger whatever in connection with this method as, should an accident happen to the glass gauge, this supply of ammonia is cut off, doing away with

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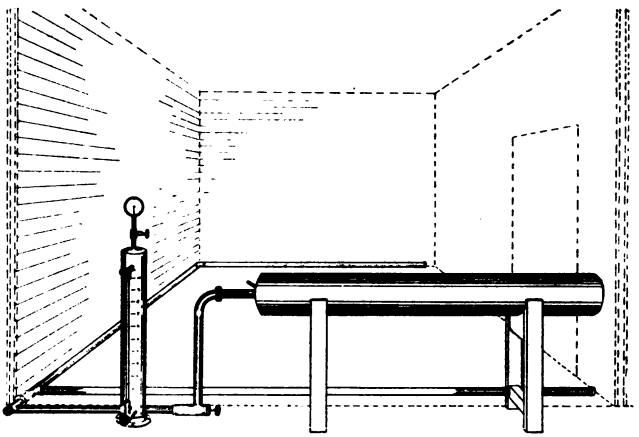
any danger. The valves are all high pressure, tested up to 500 pounds' pressure, assuring absolute safety. The time required is greatly shortened by this system, as twelve hours of fuming, or over night, produces a greater effect than from twenty-four to thirty-six hours by the old method. The operation of the system is absolutely accurate, as in setting the scale for weighing the amount of ammonia required there is no guess work or wasting of extra ammonia. The system is the application of a scientific principle taking advantage of a chemical change, controlling



Illustrating a Patented Automatic and Measuring Device for the Injection of Ammonia Gas.

it all by an ingenious device which, in itself, gives to man the use of an element by the simple turning of valves and the element then doing the work that he desires. Fumed oak, thus produced, is absolutely permanent. *Fumed oak that is fumed oak* is recognized from its imitations, and the older it grows, the better it gets, whereas, the imitation wears off at the edges, bearing its own stamp as imitation.

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SOMETHING ABOUT FUMING

THE AMOUNT OF AMMONIA TO BE USED

Fumed oak, as the name implies, should be produced by the fuming of oak. It is an established fact that when the unfinished oak is subjected to ammonia in its gaseous form, ordinarily called fumes of ammonia, the wood assumes a color which is now being marketed as fumed oak. The shades can be controlled by the length of time that the wood is subjected to the process, and the color can be greatly augmented by the application of boiled oil. The most beautiful results are obtained, however, by applying linseed oil heated, so it is just bearable to the hand, and then thoroughly rubbed into the wood. After it has dried, the process is repeated. This gives us a fumed oak of that richness that is found only in furniture a good many years old. The process of today, however, is to use one part of boiled oil and from three to four parts of naphtha which, of course, dries a good deal quicker. This being thinned, penetrates the wood and, to a certain extent, produces the hot oil effect. When this coat is dry, a thin coat of shellac is applied and then the piece is waxed and called finished.

This latter method produces a very creditable result, but it does not come up to the first-named method. When the fuming process was first employed, it was customary to use the wood of a single log. A more evenly-colored piece of furniture was the result. Today this would be a difficult proposition, because a piece of furniture is apt to be made up of wood from various logs. Again, these logs are grown on various kinds of soil. The result cannot, therefore, possibly be as uniform. After a piece made up in this way is fumed, and the oil coat has brought out the shadings and the oil is thoroughly dry, rub off any grease spots that may remain and even up by using a water solution of sulphur brown, blending it nicely by the use of a camel hair brush. Then give it a coat of shellac, preferably made of one part white shellac, one part orange shellac, and one or two parts of wood alcohol. Then apply the wax.

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On the cost of ammonia this information is furnished by George Osius, chemist of the Michigan Ammonia Works, of Detroit, Michigan:

"The present market price for aqua ammonia delivered in iron drums at any point in Michigan and other states is 5 cents per pound, containing 29.4 per cent. absolute ammonia, and 70.6 per cent. water. The market price of anhydrous ammonia in 100-pound cylinders delivered at any point in Michigan is 26 cents per pound, containing 100 per cent. of absolute ammonia. Taking the above prices as a basis, you will find that 29.4 pounds of anhydrous ammonia will cost $7.65; 29.4 pounds of ammonia gas (contained in 100 pounds aqua ammonia 26 degrees), will cost $5. Therefore, the cost of the same amount of ammonia gas used as anhydrous ammonia is over 50 per cent. more than of the same amount of ammonia gas furnished in aqua ammonia."

In both instances the above example shows exactly the same amount of ammonia in its original condition, and both present an even value of action. The original cost may slightly vary, according to package and quality. For instance, if aqua ammonia of 25 degrees is purchased in carboys, it will cost 6¼ cents per pound, and anhydrous ammonia in 50-pound cylinders 28 cents per pound. On the other hand, carload lots of aqua ammonia containing 25 drums, can be purchased at 4¾ cents per pound. Packages, in all instances, must be returned at the expense of the manufacturer.

There is absolutely no need of mentioning any other method for the use of ammonia. While it is true that it can be obtained from other methods, the time required and cost is prohibitive.

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Finishing Room Problems

THE four chapters which just precede this page, on the construction of a fuming room, and on the fuming of lumber, are from a book which is in course of preparation, and which will be published during the year 1913. It will be written by

WALTER K. SCHMIDT,
ANALYTICAL CHEMIST,

who has edited a department for two years past in THE FURNITURE MANUFACTURER AND ARTISAN on "Problems of the Finishing Room"—articles widely read and universally appreciated. It will be published by

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